2810A-02

DIGITEC CORPORATION

IQ-280A SERIES
Intelligent Digital Panel Meters
Voltmeter/Ammeter Models

Models 2810A, 2811A, 2812A, and 2820A

Operator's Manual

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P/N 88-02800A-01, Rev. E

December, 1986

PRELIMINARY INFORMATION

Safety Summary

This instrument is designed to prevent accidental shock to operator when properly used. However, no engineering design can ensure the safety of an instrument used negligently. **Therefore, read this manual carefully and completely prior to operating the instrument.** Failure to do so could seriously damage the instrument or injure the operator. Standard safety precautions must be used during installation and operation.

Important Messages

<WARNING> Denotes a hazardous procedure or condition which, if ignored, could injure or be fatal to the operator.

<CAUTION> Denotes a hazardous procedure or condition which, if ignored, could damage or destroy the instrument.

<IMPORTANT> Denotes a procedure or condition which is essential to the correct operation of the instrument.

<NOTE> Specifies supplementary and perhaps essential information which should be recognized in relation to a particular procedure or condition.

Shock Hazard (Industry Standard)

The definition of "Shock Hazard" (as defined in Underwriters Laboratories Radio and Television Receiving Appliances Standards for Safety, 12th ed., dated June 25, 1969) is provided for the safe operation of the unit.

> "Shock hazard shall be considered to exist at any part involving a potential of between 42.4 volts peak and 40 kilovolts peak in the following cases:
>
> A. If the current through a load of not less than 500 ohms exceeds 300 milliamperes after 0.0003 second.
> B. If the current through a load of not less than 500 ohms exceeds 5 milliamperes after 0.2 second.
> C. If the time required for the current through a load of not less than 500 ohms to decrease to .5 milliamperes is between 0.1 and 0.2 second, and the total quantity of electricity passed through the load up to that time exceeds 4 millicoulombs.
> D. If the time required for the current through a load of not less than 500 ohms to decrease to 5 milliamperes is between 0.03 and 0.1 second, and the total quantity of electricity passed through the load up to that time exceeds $75T-350T^2$ millicoulombs, where T is the time in seconds.
> E. If the potential is more than 5 kilovolts peak and if the total capacitance of the circuit is more than 3000 microfarads.
>
> NOTE: Additional factors might apply when potentials more than 40 kilovolts peak are present."

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For Your Information . . .

(1) Digitec Corporation claims proprietary right to the material disclosed herein. This manual is issued in confidence for engineering information only and may not be reproduced or used to manufacture anything shown without direct written permission from Digitec to user.

(2) Specifications, Parts Lists, Component Layouts, and Schematics are subject to change without notice.

(3) The terms "instrument", "unit", and "meter" are used synonymously throughout this manual.

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Section 1 - INTRODUCTION and DESCRIPTION

This manual is divided into the following sections:

Section 1 - INTRODUCTION and DESCRIPTION
Section 2 - INSTALLATION
Section 3 - OPERATION
Section 4 - SCHEMATICS, ASSEMBLY DRAWINGS, and PARTS LISTS

1.1 Unit Description

Voltmeter/Ammeter Models 2810A, 2811A, 2812A, and 2820A are part of the IQ-280A series microprocessor-based, intelligent digital panel meters. These meters are available with 3-1/2, 4, and 4-1/2 digit resolution. Three front panel soft keys allow you to select input, setpoint values and hysteresis, offset and scale, and display Min./Max. values.

Model	Digits	Display	Models That Support Option R
2810A	3-1/2	±1999	All
2811A	4	±9999	-01 thru -11
2812A	4-1/2	±19,999	-01 and -04
2820A	4	±9999	All

1.2 SelfCal™ Autocalibration

SelfCal™ is a standard autocalibration feature on all meters. A stable voltage reference (8ppm/°C) and internal self-calibrating circuit replace the need for potentiometer adjustments. SelfCal™ autocalibrates once every 4 seconds to compensate for drift.

1.3 Options

Option F: Digital Offset and Scale (standard on 2820A)
Option D: Red/Orange Display
Option C: Digital Limits, Form C Relays (dual high/low)
Option E: Parallel BCD Output
Option T: Serial Data Output (RS-232-C, 20mA Current Loop)
Option H: Analog Output
Option R: Meter accepts DC Power Input (available on limited models, see Section 1.1)

1.4 Common Specifications

- **Display:** 7 segment, 5 digit, blue-green, vacuum fluorescent, 0.5" (13mm).
- **NMR:** 60 dB typical at 50/60 Hz.
- **CMV:** ±250OV peak, input to power line with AC power supply. 150OV, input to power line with DC power supply (Option R).
- **CMRR:** 80 dB at 50/60 Hz, input to power line; 120dB at DC.
- **Case:** 1/8 DIN cutout; splashproof NEMA 12 front panel; oil-tight with panel seal gasket.
- **Dimensions:** 2" (50.8 mm) h x 3.83" (97.3 mm) w x 5.36" (136.1 mm) d.
- **Depth Behind Panel:** 5.01" (127.2mm) min. to 6.01"(152.6mm) max., depending on model and type of connector.

- **Weight:** 1.22 lb. (.553 kg) max. with AC power supply, 0.72 lb. (.327 kg with DC power supply (Option R).
- **Power (Standard):** 115VAC or 230VAC ±10%, 10VA, user-selectable on edge connector.
- **Power (Option R):** 9 to 30 VDC at 16W max. at the meter power input pins (not the power source).
- **Display Rate:** 2 updates per second nominal.
- **Response Time:** 750 ms typical for input step change.
- **Input:** Floating, protection to 150V peak, 1MΩ min. input impedance.
- **Environment:** 0 to 50°C operating temperature (0 to 45°C with Option C; 0 to 35°C with Option H or multiple options); -40°C to +85°C storage temperature. 20 to 80% relative humidity, non-condensing.
- **Terminations:** Solder Terminal Connector (Screw Terminal Connector, optional).
- **A/D Conversion:** Voltage-to-frequency, microprocessor controlled. Auto-zero, internal reference.
- **SelfCal™:** Autocalibrates once every 4 seconds. Each calibration cycle takes approximately 1 second, varying with user options. Integration time is 300.0 ms max. Temperature coefficient 50ppm/°C maximum. Internal reference temperature coefficient 8ppm/°C; stability 20ppm/1000 hours maximum (nonconcurrent). During SelfCal™, input measurement is suspended.

1.5 Model Specifications (at 23°C ±2°C)

Voltage Models	2810A-XX	2811A-XX	2812A-XX
Accuracy (±1 count)	±0.03% rdg ±0.05% rng	±0.02% rdg ±0.01% rng	±0.01% rdg ±0.005% rng
Tempco (-XX)			
-00	---	±50 ppm of rdg/°C	---
-01	±66 ppm of rdg/°C	±75 ppm of rdg/°C	±50 ppm of rdg/°C
-02	±80 ppm of rdg/°C	±75 ppm of rdg/°C	±60 ppm of rdg/°C
-03	±80 ppm of rdg/°C	±75 ppm of rdg/°C	±60 ppm of rdg/°C
-04	±80 ppm of rdg/°C	±75 ppm of rdg/°C	±60 ppm of rdg/°C
Range (-XX)			
-00	---	±99.99mV	---
-01	±199.9mV	±999.9mV	±199.99mV
-02	±1.999V	±9.999V	±1.9999V
-03	±19.99V	±99.99V	±19.999V
-04	±199.9V	±999.9V	±199.99V
Min Input Impedance (-XX)			
-00	---	>1000MΩ	---
-01	>1000MΩ	>1000MΩ	>1000MΩ
-02	1MΩ	1MΩ	1MΩ
-03	10MΩ	10MΩ	10MΩ
-04	10MΩ	10MΩ	10MΩ

Current Models	2810A-XX	2811A-XX
Accuracy (±1 count)	±0.08% rdg ±0.05% rng	±0.07% rdg ±0.005% rng
Tempco	±100 ppm of rdg/°C	±90 ppm of rdg/°C
Range (-XX)		
-08	±199.9µA (1KΩ Shunt)	±999.9µA (1KΩ Shunt)
-09	±1.999mA (100Ω Shunt)	±9.999mA (100Ω Shunt)
-10	±19.99mA (10Ω Shunt)	±99.99mA (10Ω Shunt)
-11	±199.9mA (1Ω Shunt)	±999.9mA (1Ω Shunt)
-12	±1.999A (.1Ω Shunt)	---

Process Monitor Model	2820A-XX		
Accuracy (±1 count)	±0.02% rdg ±0.01% rng		
Tempco	±0.008% rdg ±0.002% f.s./°C		
Range (-XX)		Recalibration Input (-XX)	
-23	0 to +5V, +1 to +5V	-23	±10V
-25	0 to +10V, -10 to +10V	-25	±10V
-27	0 to 20mA, 4 to 20mA (50Ω Shunt)	-27	±20mA
-29	0 to 50mA, 10 to 50mA (20Ω Shunt)	-29	±50mA
Min Input Impedance (-XX)			
-23	1MΩ		
-25	1MΩ		

Section 2 - INSTALLATION

The Installation Section is broken down into the following sections:

Section 2.1 Installation and Assembly
Section 2.2 Electrical Connections
Section 2.3 Recalibrate Meter
Section 2.4 P2 Edge Connector Pin-Outs (Option Board)
Section 2.5 Option C - Digital Limits, Form C Relay Outputs
Section 2.6 Option E - Parallel BCD Output
Section 2.7 Option T - Serial Output (ASCII)
Section 2.8 Option H - Analog Output

2.1 Installation and Assembly

IMPORTANT: Each meter is shipped with a specific connector that was on the meter when it was calibrated at the factory. DO NOT try to use the meter with a different connector. It must use the connector with which it was factory calibrated to ensure accurate measurements. The meter and connector are identified by stickers with matching serial numbers.

Refer to Figure 1 for unit installation and assembly.

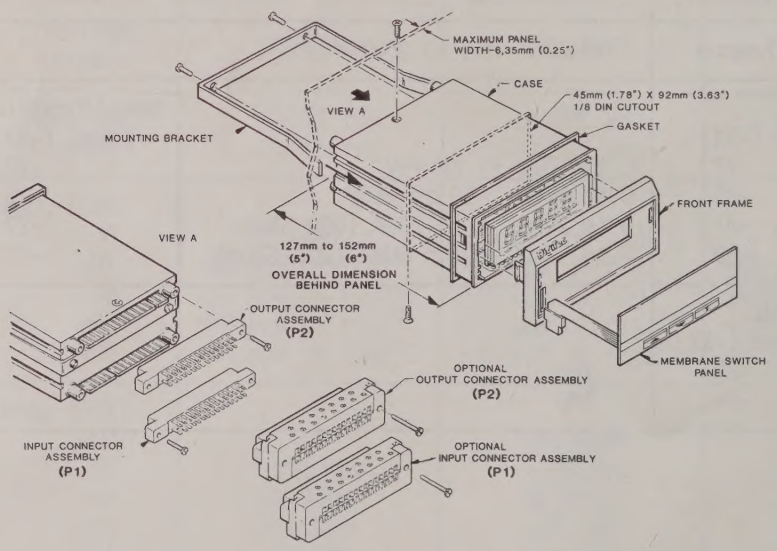


Figure 1. Unit Installation and Assembly

2.2 Electrical Connections (P1 Edge Connector)

WARNING:

When making connections to the P1 Edge Connector, remember that these pins float to the potential applied to P1, Pin R. Refer to the Safety Summary on page 'i' at the beginning of this manual.

2.2.1 P1 Edge Connector Pin-Outs for AC Power Supply

Pin	Description
1, 3, A, C	AC power input.
5	Earth ground. Tie to AC power input grounding wire. **Do not allow to float.**
2, 4, 6	Reserved (do not use).
13, B	Reserved (do not use).
D, E, F	Reserved (do not use).
7	Data. Used for field recalibration.
8	Reserved (do not use).
9	When connected through a push button switch to Pin K, switch functions as the ▲ key.
H	When connected through a push button switch to Pin K, switch functions as the ▼ key.
J	When connected through a push button switch to Pin K, switch functions as the <S> key.
K	Strobe common for keyboard and Strobe/Hold.
L	When tied to Pin K, holds the count in the display and stops signal processing (Strobe/Hold).
11	-15V power supply, test point only.
12	+15V power supply, test point only.
N	Internal power supply common return line. Used for field recalibration.
M	Clock in. Used for field recalibration.
10	+5V power supply, test point only.
S	Signal ground.
15	Reserved (do not use).
P, R, 14	Input terminations (see Figures 3A, 3B, and 3C).

Figure 2A shows the P1 Edge Connector Pin-outs (with AC power supply) on the Main Logic Board.

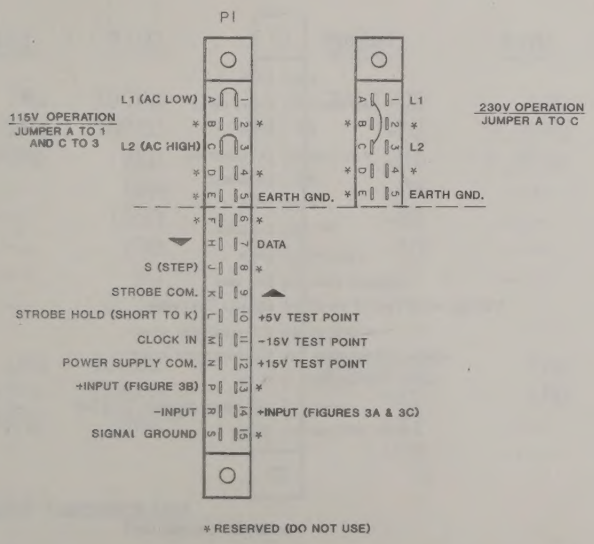


Figure 2. P1 Edge Connector

2.2.2 P1 Edge Connector Pin-Outs for DC Power Supply (Option R)

Pin	Description
2, B	DC power +V input.
4, D	DC power V return.
5	Shield. Tie to power input shielding wire if available. **Do not connect to input or return.**
1, 3, 6	Reserved (do not use).
13, A	Reserved (do not use).
C, E, F	Reserved (do not use).
7	Data. Used for field recalibration.
8	Reserved (do not use).
9	When connected through a push button switch to Pin K, switch functions as the ▲ key.
H	When connected through a push button switch to Pin K, switch functions as the ▼ key.
J	When connected through a push button switch to Pin K, switch functions as the <S> key.
K	Strobe common for keyboard and Strobe/Hold.
L	When tied to Pin K, holds the count in the display and stops signal processing (Strobe/Hold).
11	-15V power supply, test point only.
12	+15V power supply, test point only.
N	Internal power supply common return line. Used for field recalibration.
M	Clock in. Used for field recalibration.
10	+5V power supply, test point only.
S	Signal ground.
15	Reserved (do not use).
P, R, 14	Input terminations (see Figures 3A, 3B, and 3C).

Figure 2 shows the P1 Edge Connector Pin-outs (with DC power supply) on the Main Logic Board.

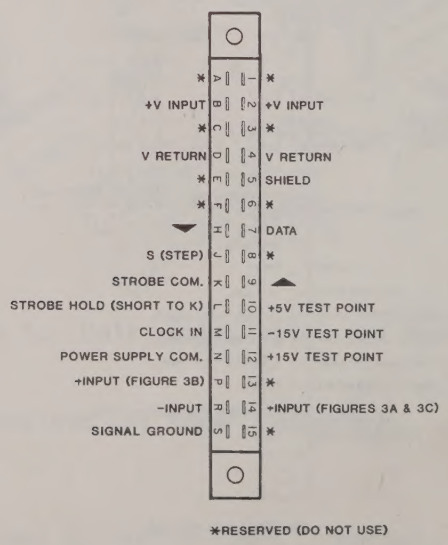


Figure 2. P1 Edge Connector

2.2.3 Input Connections

Using Figure 3A, 3B, or 3C, make the proper signal input connections to the P1 Edge Connector.

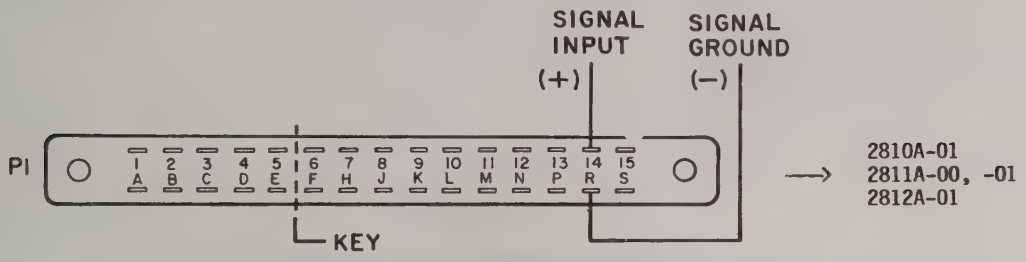


Figure 3A. Input Connections

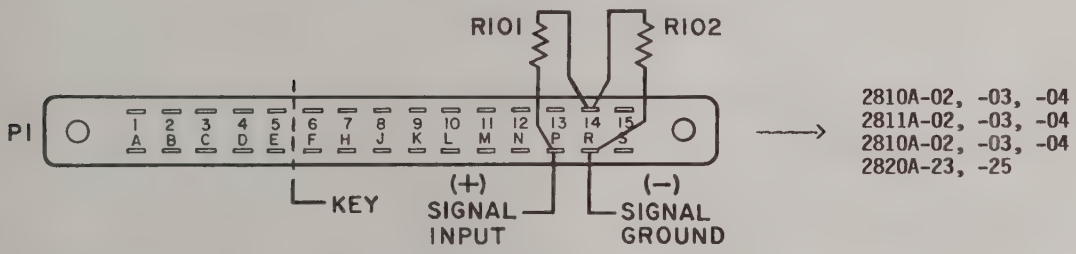


Figure 3B. Input Connections

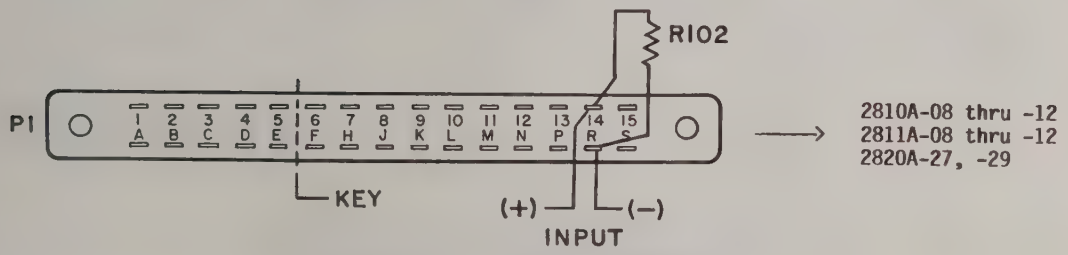


Figure 3C. Input Connections

Model	R101	R102	Model	R101	R102
2810-02	1MΩ	100KΩ	2811-02	1MΩ	100KΩ
-03	9.99MΩ	100KΩ	-03	9.99MΩ	100KΩ
-04	9.99MΩ	10KΩ	-04	9.99MΩ	10KΩ
-08	----	1KΩ	-08	----	1KΩ
-09	----	100Ω	-09	----	100Ω
-10	----	10Ω	-10	----	10Ω
-11	----	1Ω	-11	----	1Ω
-12	----	0.1Ω			
2812-02	1MΩ	100KΩ	2820-23	1MΩ	100KΩ
-03	9.99MΩ	100KΩ	-25	1MΩ	100KΩ
-04	9.99MΩ	10KΩ	-27	----	50Ω
			-29	----	20Ω

2.2.4 Strobe/Hold Connection

When strobe/hold is connected, all analog processing stops and the display freezes. To connect strobe/hold, short Pin L to Pin K.

2.2.5 Power Connections

115VAC Operation (see Figure 4A)

1. Make sure the connector is right-side-up.
2. Connect L1 (AC Low) to P1, pin 1 and pin A.
3. Connect L2 (AC High) to P1, pin C and pin 3.
4. Connect earth ground to Pin 5.
5. Check connections.

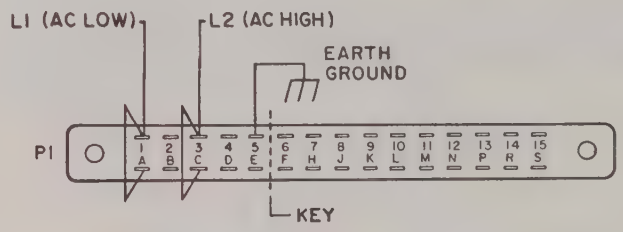


Figure 4A. Power Connections - 115V Operation

230VAC Operation (see Figure 4B)

1. Make sure connector is right-side-up.
2. Connect L2 to P1, pin 3.
3. Connect L1 to P1, pin 1.
4. Connect P1, pin A and pin C together.
5. Connect earth ground to Pin 5.
6. Check connections.

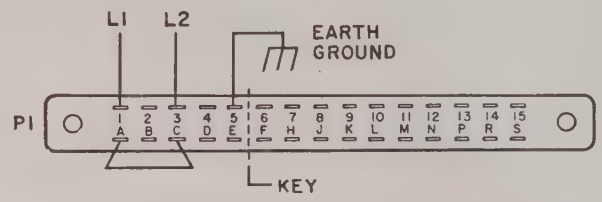


Figure 4B. Power Connections - 230V Operation

DC Operation (see Figure 4C)

1. Make sure the connector is right-side-up.
2. Connect +V input to either pin 2 or pin B on the P1 edge connector.
3. Connect V return to either pin 4 or pin D on the P1 edge connector.
4. Connect shield drain wire to pin 5.
5. Check connections.

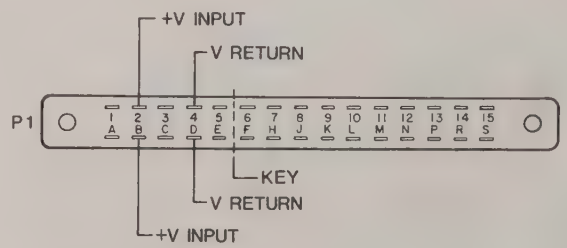


Figure 4C. Power Connections - DC Operation

2.3 Recalibrate Meter (refer to Figure 5)

WARNING: When making connections to the P1 Edge Connector, remember that these pins float to the potential applied to P1, Pin R. Refer to the Safety Summary on page 'i' at the beginning of this manual.

All meters can be recalibrated. Since most component settling occurs during the first year of operation, recalibration should be done after one year of use. Recalibration is optional.

Procedure

1. On the P1 Connector, connect one momentary ON pushbutton (S1) between Pins 7 and N (data and common).
2. Connect another momentary ON pushbutton (S2) between Pins M and N (clock and common).
3. Connect the DC calibrator to the input terminal (see Section 2.2.3 to make connections) and apply OV or OA, depending on the type of meter you are calibrating.
4. Press the S1 pushbutton for at least 3 seconds then release.
5. Adjust the calibration standard to +(full scale). See Section 1.5 for this value for your particular model. **NOTE:** Unit reading should not change.
6. Wait at least 5 seconds.
7. Momentarily press the S2 pushbutton.
8. Adjust the calibration standard to -(full scale). See Section 1.5 for this value for your particular model.
9. Press the S2 pushbutton.
10. Remove recalibration connections from the P1 connector.

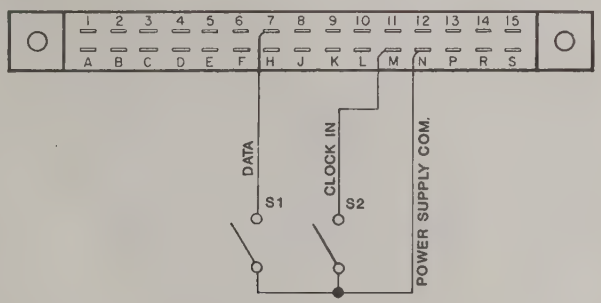


Figure 5. Recalibration Connections (P1 Connector)

2.4 P2 Edge Connector Pin-Outs

Figure 6A depicts the connections made to the P2 edge connector on the C Option Board.

Figure 6B depicts the connections made to the P2 edge connector on the C and E Option Board.

Figure 6C depicts the connections made to the P2 Edge Connector on the "H" (Analog Output) and/or "T" (Serial Output) Option Board. Option C (Relays Output) pin configuration, as shown, is valid only when installed in conjunction with Option H and/or Option T.

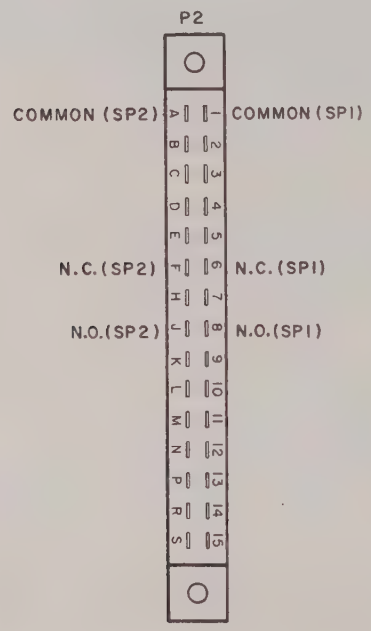


Figure 6A. P2 Edge Connector Option C (Relays Output)

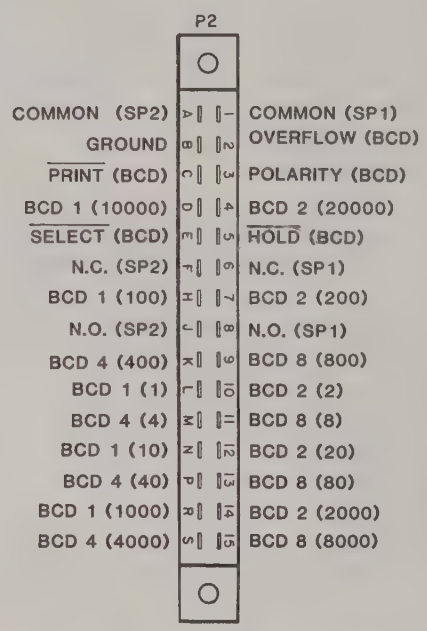


Figure 6B. P2 Edge Connector Option C (Relays Output) and Option E (BCD Output)

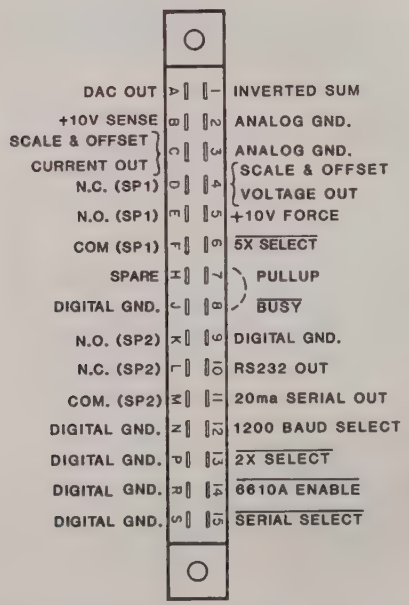


Figure 6C. P2 Edge Connector for Option C (Relays Output) and Option H (Analog Output) and Option T (Serial Output)

2.5 Option C - Digital Limits, Form C Relay Outputs

2.5.1 Option C Description

Option C Rating: Resistive: 5A max. at 125VAC max.; 0.6A max. at 110VDC max.; 5A max. at 30VDC max.
Inductive: 0.1A max. at 50VDC max.

Option C has 1500Vpk isolation from the signal input and 500Vpk isolation from Option E, T, or H when Option C is used in conjunction with any of these options.

Option C provides two Form C, 5 amp relays with high and low setpoints giving the meter a total of 4 setpoints with deadband (hysteresis). These setpoints are programmed using the front panel keypad.

If either SP1H or SP1L is exceeded, the SP1 relay will be activated. If either SP2H or SP2L is exceeded, the SP2 relay will be activated.

2.5.2 Alarm Condition

When input exceeds a setpoint (SP), the meter goes into an alarm condition. During an alarm condition, the display alternates between an alarm message (Hi or Lo) and the present reading, and the corresponding relay output is activated. An example of the Setpoints with Hysteresis is illustrated in the following graph. Alarm Messages which may appear during an alarm condition are listed after the graph.

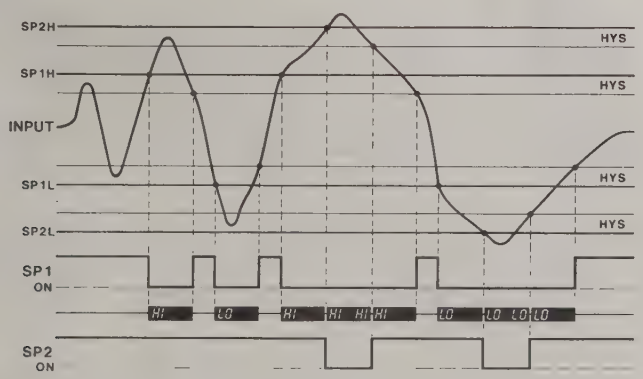


Figure 7. Setpoints with Hysteresis

Alarm Message	Description
[Hi]	SP1H exceeded. Display flashes present reading.
[Lo]	SP1L exceeded. Display flashes present reading.
[Hi]	SP2H exceeded. Display flashes present reading.
[Lo]	SP2L exceeded. Display flashes present reading.
[Hi Hi]	SP1H and SP2H exceeded. Display flashes present reading.
[Lo Lo]	SP1L and SP2L exceeded. Display flashes present reading.
[Hi Lo]	SP1H and SP2L exceeded. Display flashes present reading.
[Lo Hi]	SP1L and SP2H exceeded. Display flashes present reading.

2.5.3 Option C Connections

Refer to Figures 6A, 6B, 6C (P2 Edge Connector) and Figures 13, 15 (P.C. Option Board Schematic).

NOTE: To obtain maximum contact life, or when Option C is used in conjunction with Option E, T, or H, relay contacts should have arc suppression on the P2 edge connector. No internal arc suppression is provided. Use 0.047µF/500V ceramic disc in series with 10 ohm, 1/2 W resistor.

When Option C is installed alone or with Option E, SP1H and SP1L control Pins 1, 6, and 8 on the P2 Edge Connector. SP2H and SP2L control Pins A, F, and J on the P2 Connector.

When Option C is installed with Option H and/or Option T, SP1H and SP1L control Pins D, E, and F on the P2 Edge Connector. SP2H and SP2L control Pins K, L, and M on the P2 Edge Connector.

2.6 Option E - Parallel BCD Output

Option E is a tri-state parallel BCD output with 1500Vpk isolation to the signal input.

Specifications

- **Output:** Logic Low 0 = 0.45V (max.) at 1.6mA Sink. Logic High 1 = 2.4V (min.) at 50µA Source.
- **20 BCD Lines:** Parallel BCD data output, one TTL load compatible, valid while $\overline{\text{SELECT}}$ (Pin E) is Low.
- **$\overline{\text{PRINT}}$ (Pin C):** Low for valid BCD data. Goes high for 100µs while new data is being written to BCD data lines. Falling edge can be used as print command for a receiving device. **NOTE:** This pin can also be referred to as BUSY.
- **POLARITY (Pin 3):** Logic Low indicates a positive reading.
- **$\overline{\text{HOLD}}$ (Pin 5):** When Pin 5 receives a Logic Low, the meter maintains present BCD output until a Logic High is applied. Processing continues while the meter is in the "hold" state.
- **$\overline{\text{SELECT}}$ (Pin E):** When Pin E receives a Logic Low, the state of the 20 BCD Lines is checked. If all lines are tri-state, the unit writes to the BCD Lines and $\overline{\text{PRINT}}$ (Pin C) goes Low. If any BCD Lines are active, the unit does not write and $\overline{\text{PRINT}}$ stays High.
- **$\overline{\text{OVERFLOW/DATA VALID}}$ (Pin 2):** When reading is greater than full scale, Pin 2 goes Logic High.

2.6.1 Option E Connections

Option E connections are made to the P2 connector (see Figure 6B) on the Parallel BCD option board.

To connect the meter to a Digitec Model 6630A printer, refer to the connections diagram in Figure 8. Refer to your Model 6630A Operator's Manual for more information.

If this meter will be connected to a Digitec Model 6630A printer, and you will have more than one meter connected to the same printer, connect the appropriate SELECT pin of the printer to the SELECT pin of the meter, then connect a jumper between the meter SELECT pin and the meter HOLD pin.

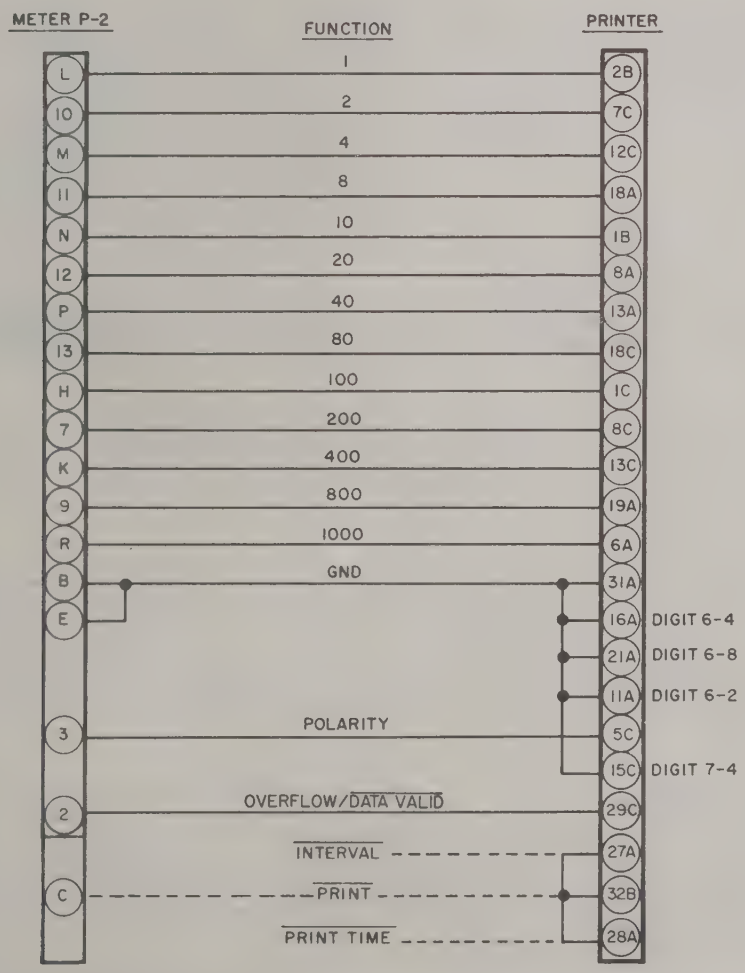


Figure 8. Meter-To-Printer Connections

2.7 Option T - Serial Output (ASCII)

Option T provides 20mA and TTL-compatible serial output capability. The optically isolated 20mA current source interface can be operated 4-wire half-duplex while providing up to 1500V peak isolation.

Specifications

- **Output:** Half duplex, isolated ASCII 20mA current source or RS-232.

- **Baud Rate:** 300 or 1200 bits/sec., external jumper selectable. For 1200 baud, short Pin 12 and Pin N on P2 connector. For 300 baud, leave both pins open.

- **Format:** 1 start bit; 7 data bits, no parity check; 2 stop bits.

- **Transmission Sequence:** ASCII characters comprised of polarity, 5 digits (with dP location), and CR LF.

- **$\overline{\text{SERIAL SELECT}}$ (Pin 15):** Logic 0 = -0.5V (min.) to 0.8V (max.) at 1mA sink, selected. Logic 1 = 2.0V (min.) to 5.0V (max.) internal 5.6K pull up not selected.

  When $\overline{\text{SERIAL SELECT}}$ is pulled to Logic Low, a new line of data is transmitted over RS-232 and 20mA lines. For continuous printing, short Pin 15 to Pin S.

- **$\overline{\text{BUSY}}$ (Pin 8):** Logic 0 = 0.5V (max.) to -50V (min.), hold transmissions. Logic 1 = 1.5V (min.) to 50V (max.) at 20mA source, resume transmission.

  The $\overline{\text{BUSY}}$ line functions as a handshake to control the flow of data. If BUSY is taken Low, the meter will terminate the transmission of data after the character currently in transmission is transmitted. Transmission will resume where it left off when BUSY is returned High. If BUSY is not used, it must be jumpered to Pin 7 to pull it high.

- **$\overline{\text{6610A ENABLE}}$:** The RTS line (Pin 4 of Digitec Model 6610A Printer Connector) functions as an interval output and as a handshake line during "6610A Enable" operation. The pulse outputted by the real time clock (from the 6610AK printer) on a timed interval is input into the BUSY line (Pin 8).

- **Distance:** 20mA current loop = 4000 ft. at 300 or 1200 baud; RS-232-C = 75 ft. max.

2.7.1 Option T Connections (see Figure 9)

Data Transmission

The BUSY line functions as a handshake to control the flow of data. If BUSY is taken Low, data transmission will terminate after the last character being transmitted completes transmission. Data transmission will resume where it left off when BUSY is returned High. If BUSY is not used, jumper Pin 8 to Pin 7.

Single Line Transmission

To transmit one line of data output only, the SERIAL SELECT line must be pulsed Low for 10ms to 50ms and then returned High. If SERIAL SELECT is held Low longer than 50ms, multiple outputs will occur.

Interval Output (Datalogging)

The "6610A Enable" works specifically with Digitec 6610A Series printers. With the printer, the meter becomes a simple datalogging system.

The only difference in wiring between normal operation and using "6610A Enable" is the jumper between Pin 14 and Pin R on the option board connector.

The 6610AK printer is a serial input impact printer with a real time clock. The real time clock can output a pulse on a timed interval. The pulse can then be used to trigger the meter to output one line of data. This line consists of the 6610AK's print date command (1BH, 44H), print clock command (1BH, 54H), and the meter's data, allowing date, time, and data to be printed on the same line.

The RTS line (6610AK connector pin 4) then functions as both an interval output and handshake line. A pulse is output from the RTS line (Pin 4) and input into the meter's BUSY line (Pin 8).

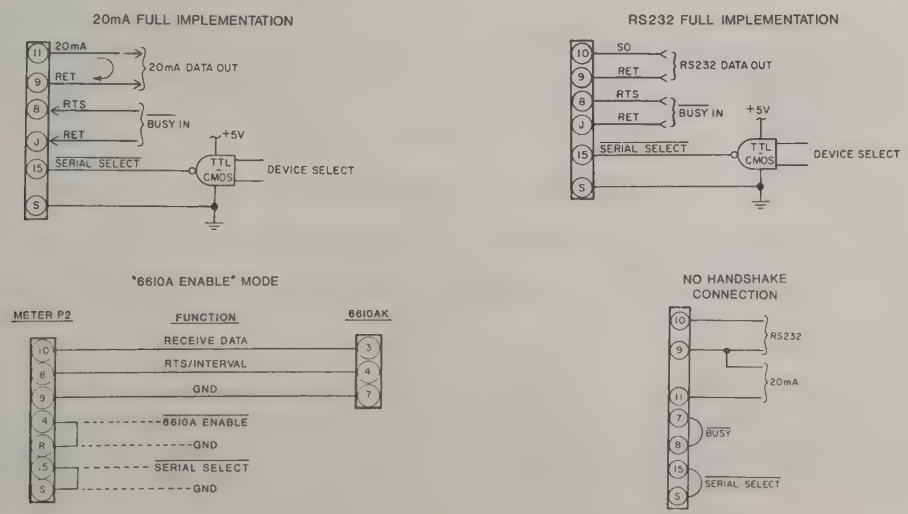


Figure 9. Various Option T Connections

2.8 Option H - Analog Output

Option H contains a 12 bit, D/A converter and current transmitter that enable the meter to interface with analog devices. Analog output is derived from the display. If the meter has Option F for scaling and offsetting the display, this should be done first, and should not be confused with the scale (R17) and offset (R12) used in Option H.

In the following specifications, reference is made to NORMAL and EXTENDED operation. NORMAL operation is when the SCALE trimpot is (R17 in Figure 10) is below X5, EXTENDED operation is when the scale trimpot is from X5 to X20. Do not confuse these scale factors with X1, X2, or X5 modes of operation. They are different.

2.8.1 H Option Specifications - NORMAL OPERATION

MODEL	DISPLAY COUNTS	X1 Mode	
		*DAC Output Typical mV/cnt	**Minimum Display Count Change for Full Output Span
2810A	-1999 to 1999	2.5mV/count	800
2811A/20A	-9999 to 9999	2.5mV/5 counts	4000
2812A	-19999 to 19999	2.5mV/10 counts	8000

MODEL	DISPLAY COUNTS	X2 Mode	
		*DAC Output Typical mV/cnt	**Minimum Display Count Change for Full Output Span
2810A	0 to 1999	5mV/count	400
2811A/20A	0 to 9999	2.5mV/2.5 counts	2000
2812A	0 to 19999	2.5mV/5 counts	4000

* Typical DAC output is the average change in DAC output voltage (prior to scale (R17) and offset (R12) adjustments) due to the specified count change in the display. Actual resolution of the DAC is 2.441mV per step times 4095 steps.

** With R17 set for a gain of 5.

MODEL	DISPLAY COUNTS	X5 Mode	
		*DAC Output Typical mV/cnt	**Minimum Display Count Change for Full Output Span
2810A	0 to 799	12.5mV/count	160
2811A/20A	0 to 3999	2.5mV/count	800
2812A	0 to 7999	2.5mV/2 counts	1600

* Typical DAC output is the average change in DAC output voltage (prior to scale (R17) and offset (R12) adjustments) due to the specified count change in the display. Actual resolution of the DAC is 2.441mV per step times 4095 steps.

** With R17 set for a gain of 5.

- o Operating Temperature: 0 to 35°C
- o Stability: 0.35% + 0.02%/°C after 1 hour warmup
- o Linearity: Adjustable scaling (±0.5% setability)
- o Offset Error: Adjustable offset (±1% setability)
- o Offset Range with R12: From -100% of output to +36% of output (min.)
- o Output: Voltage, 10VDC at 17mA (max.); Current, 20mA 17V compliance (min.)
- o DAC Resolution: 12 bit (1 part in 4096)
- o Output Resolution: Shown on charts above. Listed output values increase as the scale setting increases.
- o Scale Range with R17: 0.5 to 5 (Normal), 5 to 20 (Extended)

2.8.2 H Option Specifications - EXTENDED OPERATION

MODEL	DISPLAY COUNTS	X1 Mode	
		*DAC Output Typical mV/cnt	**Minimum Display Count Change for Full Output Span
2810A	-1999 to 1999	2.5mV/count	200
2811A/20A	-9999 to 9999	2.5mV/5 counts	1000
2812A	-19999 to 19999	2.5mV/10 counts	2000

* Typical DAC output is the average change in DAC output voltage (prior to scale (R17) and offset (R12) adjustments) due to the specified count change in the display. Actual resolution of the DAC is 2.441mV per step times 4095 steps.

** With R17 set for a gain of 20.

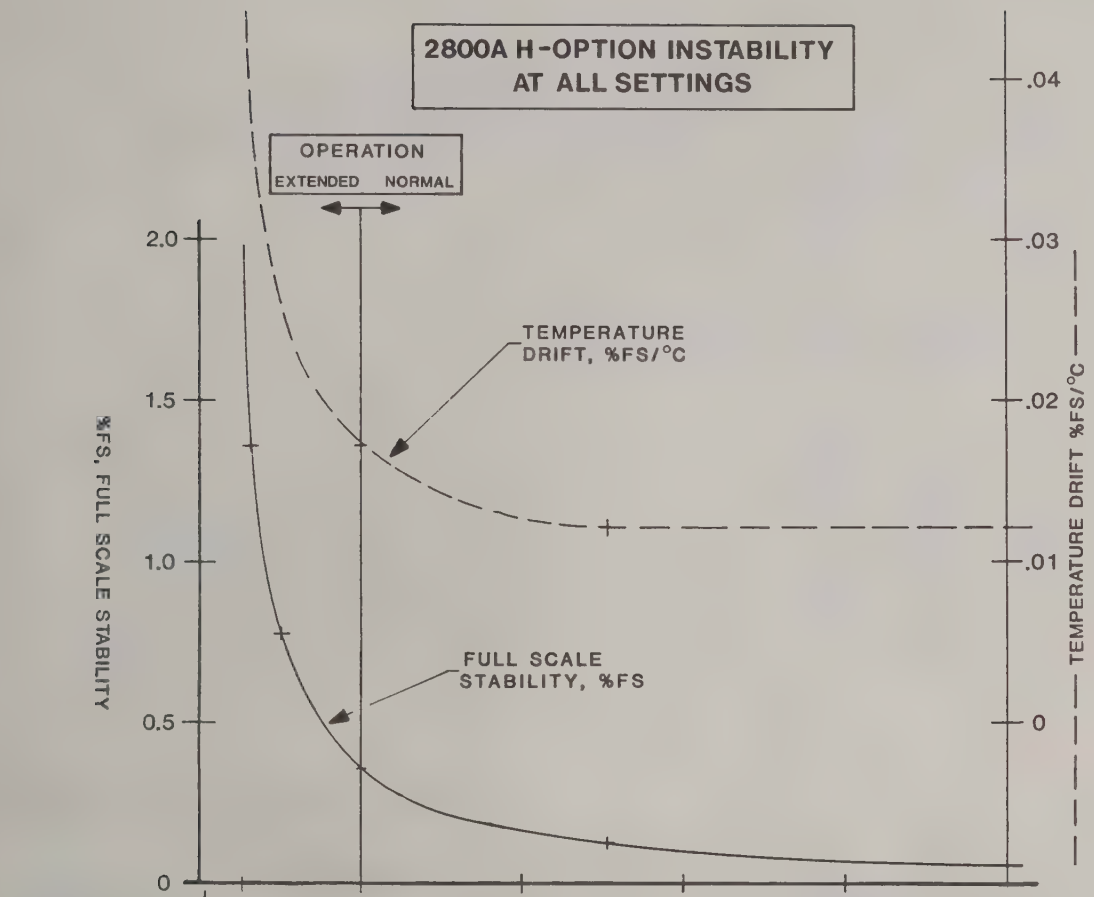
MODEL	DISPLAY COUNTS	X2 Mode	
		*DAC Output Typical mV/cnt	**Minimum Display Count Change for Full Output Span
2810A	0 to 1999	5mV/count	100
2811A/20A	0 to 9999	2.5mV/2.5 counts	500
2812A	0 to 19999	2.5mV/5 counts	1000

MODEL	DISPLAY COUNTS	X5 Mode	
		*DAC Output Typical mV/cnt	**Minimum Display Count Change for Full Output Span
2810A	0 to 799	12.5mV/count	40
2811A/20A	0 to 3999	2.5mV/count	200
2812A	0 to 7999	2.5mV/2 counts	400

* Typical DAC output is the average change in DAC output voltage (prior to scale (R17) and offset (R12) adjustments) due to the specified count change in the display. Actual resolution of the DAC is 2.441mV per step times 4095 steps.

** With R17 set for a gain of 20.

- o Operating Temperature: 0 to 35°C
- o Stability: 2% + 0.05%/°C after 1 hour warmup
- o Linearity: Adjustable scaling (±5% setability)
- o Offset Error: Adjustable offset (±5% setability)
- o Offset Range with R12: From -100% of output to +36% of output (min.)
- o Output: Voltage, 10VDC at 17mA (max.); Current, 20mA 17V compliance (min.)
- o DAC Resolution: 12 bit (1 part in 4096)
- o Output Resolution: Shown on charts above. Listed output values increase as the scale setting increases.
- o Scale Range with R17: 0.5 to 5 (Normal), 5 to 20 (Extended)

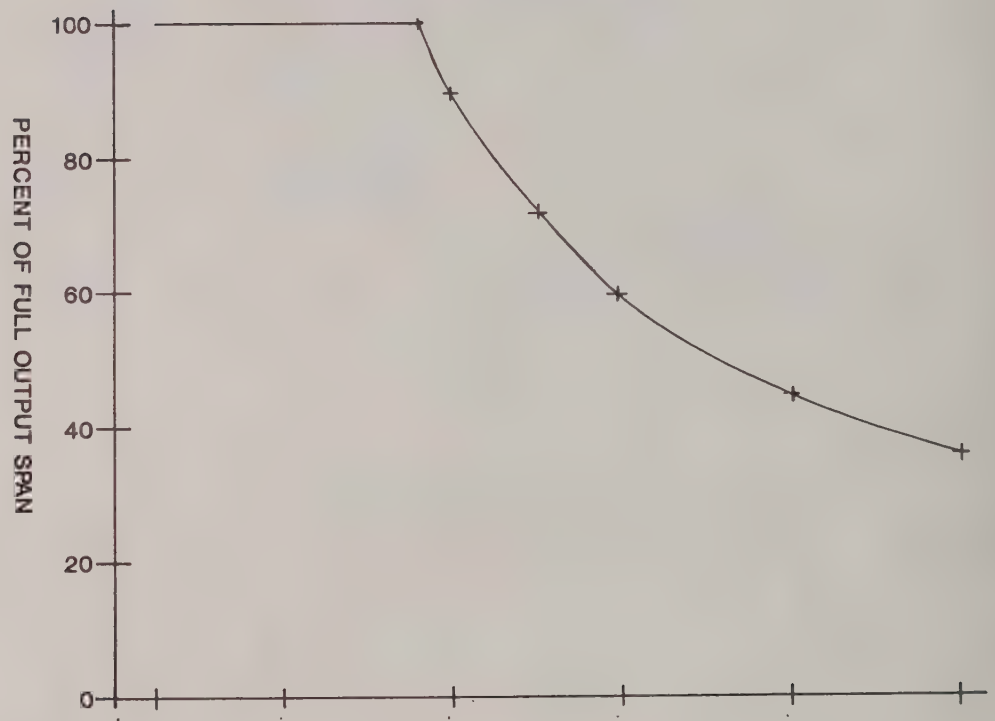


R17 SCALE ADJ. →		X20	X5	X2.5	X1.67	X1.25	X1
2811/2820	X1	1000	4000	8000	12,000	16,000	20,000
	X2	500	2000	4000	6000	8000	10,000
	X5	200	800	1600	2400	3200	4000
2810	X1	200	800	1600	2400	3200	4000
	X2	100	400	800	1200	1600	2000
	X5	40	160	320	480	640	800
2812	X1	2000	8000	16,000	24,000	32,000	40,000
	X2	1000	4000	8000	12,000	16,000	20,000
	X5	400	1600	3200	4800	6400	8000
2830/31 DISPLAY °C or °F	X1	200	800	1600	2400	3200	4000
	X2	175	700	1400	2100	2800	3500
	X5	59	234	468	701	935	1092

SOFTWARE SELECTION

DISPLAY COUNT CHANGE FOR FULL OUTPUT SPAN

2800A H-OPTION
R12 POSITIVE OFFSET ADJUSTMENT



R17 SCALE ADJ.→		X20	X5	X2.5	X1.67	X1.25	X1
2811/ 2820	X1	1000	4000	8000	12,000	16,000	20,000
	X2	500	2000	4000	6000	8000	10,000
	X5	200	800	1600	2400	3200	4000
2810	X1	200	800	1600	2400	3200	4000
	X2	100	400	800	1200	1600	2000
	X5	40	160	320	480	640	800
2812	X1	2000	8000	16,000	24,000	32,000	40,000
	X2	1000	4000	8000	12,000	16,000	20,000
	X5	400	1600	3200	4800	6400	8000
2830/31 DISPLAY °C or °F	X1	200	800	1600	2400	3200	4000
	X2	175	700	1400	2100	2800	3500
	X5	59	234	468	701	935	1092

SOFTWARE SELECTION ↑

DISPLAY COUNT CHANGE FOR FULL OUTPUT SPAN

2.8.3 P2 Edge Connector Pin-Outs for Option H

Pin	Function
A	Raw DAC output. Zero to +10 volts full scale. Not zero or gain trimmed. Can source 5mA max. If a load is applied, it must be >2,000Ω.
1	Inverted sum of the DAC output plus the offset value determined by R12 trimpot. Can source up to 2mA and is used as a setup testpoint only.
B	Sense input for 10V compliance (excitation) source.
5	+10V compliance (excitation) source. Must be tied to pin B at transducer or at P2 connector for proper operation. Output can source up to 90mA.
2	Analog ground for pins A, B, 1, 5.
3	Analog ground for pins C, 4.
H	Spare.
6	X5 Select.
4	Scaled and offset voltage output controlled by the DAC plus trimpots R12 and R17. Output can supply up to 17mA and is the input to the analog current transmitter, U6.
C	Scaled and offset analog current transmitter output. Has overall range of 0 to 23 mA and can easily be adjusted to cover 4 to 20 mA with R12 and R17.
13	X2 Select.

2.8.4 Bipolar, Unipolar Connections

Current and voltage outputs are adjusted by the same potentiometers. At minimum current output, voltage output is at the minimum (and vice versa) and at maximum current output, voltage output is at the maximum (and vice versa). However, the relationship is not exact.

Bipolar Operation (X1 Mode)

During bipolar operation, the output span corresponds to both positive and negative display values.

Current Output: On the P2 connector, connect (+) R Load to Pin C and connect (-) R Load to Pin 3.

When the display is at negative full scale, current output is at the minimum (typically 4mA). When the display is at positive full scale, current output is at the maximum (typically 20mA).

Voltage Output: On the P2 connector, connect (+) R Load to pin 4 and connect (-) R Load to pin 3.

When the display is at negative full scale, voltage output is at the minimum (typically 2V). When the display is at positive full scale, voltage output is at the maximum (typically 12V).

Unipolar Operation (X2 Mode)

During unipolar operation, the output span corresponds to only positive display values. The "2X Select" hook-up makes negative input equal to zero. To select X2, connect P2, Pin 13 to P2, Pin P.

Current Output: On the P2 connector, first make the X2 connection, then connect (+) R Load to Pin C and then (-) R Load to Pin 3.

When the display is at zero (0), current output is at the minimum (typically 4mA). When the display is at positive full scale, current output is at the maximum (typically 20mA).

Voltage Output: On the P2 connector, first make the X2 connection, then connect (+) R Load to Pin 4 and (-) R Load to Pin 3.

When the display is at zero, voltage output is at the minimum (typically 2V). When the display is at positive full scale, voltage output is at the maximum (typically 12V).

Unipolar Operation (X5 Mode)

During unipolar operation, the output span corresponds to only positive display values. The "5X Select" hook-up makes negative input equal to zero. To select X5, connect P2, Pin 6 to P2, Pin P.

Current Output: On the P2 connector, first make the X5 connection, then connect (+) R Load to Pin C and then (-) R Load to Pin 3.

When the display is at zero (0), current output is at the minimum (typically 4mA). When the display is at 40% of positive full scale, current output is at the maximum (typically 20mA).

Voltage Output: On the P2 connector, first make the X5 connection, then connect (+) R Load to Pin 4 and (-) R Load to Pin 3.

When the display is at zero, voltage output is at the minimum (typically 2V). When the display is at 40% of positive full scale, voltage output is at the maximum (typically 12V).

2.8.5 10V Compliance (Excitation) Adjustment (refer to Figure 10)

Pin B on the P2 Edge Connector is the sense input for the 10V excitation source. Pin 5 is the +10V excitation source. For proper operation, pin 5 must be tied to pin B at either the transducer or the P2 connector. This output can source up to 90mA. R19 (trimpot, see Figure 10) is the +10V excitation adjustment and has a range of +9Vdc to +11Vdc. Turn R19 clockwise to increase the voltage. This adjustment is not important to the operation of the DAC.

IMPORTANT: When this +10V exciter is used, the isolation between the signal input and analog output may be compromised. If Option T is being used concurrently, it too may have compromised isolation. Option C, if present, is not affected.

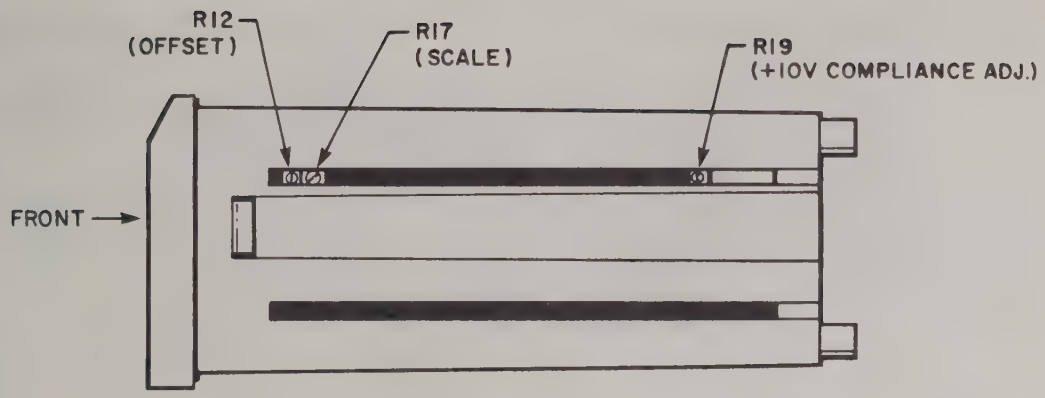


Figure 10. Analog Output Trimpot Positions

2.8.6 Analog Output Adjustment (refer to Figure 10)

The loop load resistance range for 4-20mA operation of this meter is 0 to 600 ohms. The loop is returned to Pin 3 on the P2 edge connector.

Adjust the 4-20mA current transmitter as follows:

1. Connect a volt meter between Pins 1 (+) and 2 (-) on the P2 edge connector.

2. Connect a current monitor to the transmitter loop at P2 Pin C (+) and Pin 3 (-) and measure the loop current, or calculate the loop current by measuring the voltage across the load resistance and dividing that reading by the measured value of the load resistance.

3. To the meter input, apply a potential that causes the lowest planned display reading and adjust R12 (OFFSET) until the voltage at P2 Pin 1 goes to zero or slightly negative (to get any output from the current transmitter, this point must be at some negative potential).

4. With the display remaining at its lowest count, slowly rock the offset trimpot R12 back and forth until the current transmitter shows a small positive output current near zero (approximately 10-100μA).

5. To the meter input, apply a potential that causes the highest planned display reading and adjust R17 (SCALE) for 16mA in the loop. Turn R17 clockwise to decrease current in the loop.

6. With the display remaining at its highest count, adjust R12 (OFFSET) until the loop current reaches 20mA. Turn R12 clockwise to increase the pedestal (OFFSET) current in the loop.

7. To the meter input, apply a potential that causes the lowest planned display reading and check the pedestal (OFFSET) current to verify it is 4mA. If it is not 4mA, repeat steps 4, 5, and 6 until it is.

Section 3 - OPERATION

Section 3 describes how to operate the meter using the front panel keypad, and is broken down into the following sections:

Section 3.1 Normal Operation
Section 3.2 Alarm Conditions
Section 3.3 Setup Mode
Section 3.4 Digital Offset and Scale
Section 3.5 Overflow Condition

3.1 Normal Operation

When the meter is in the Run (normal) Mode, it displays the present reading. If any setpoint is exceeded, the meter goes into an alarm condition.

3.1.1 Nonvolatile Memory

All meters feature a nonvolatile memory, in addition to a temporary memory. The nonvolatile memory is maintained even when power to the meter is off. The temporary memory is used during the Setup Mode to store selected values until they are transferred to nonvolatile memory after exiting the Setup Mode. This feature makes it unnecessary to reprogram the meter each time it is turned on.

3.1.2 Min./Max. Feature

The Min./Max. feature keeps track of the highest and lowest readings since the values were last cleared. Press ▲ to display the highest reading or ▼ to display the lowest reading.

IMPORTANT: Min./Max. must be reset whenever the meter is turned on.

To reset Min., press and hold ▼ , then press <S>. Release <S> and then ▼. The positive full scale value will flash on the display, followed by the present reading.

To reset Max., press and hold ▲ , then press <S>. Release <S> and then ▲. The negative full scale value will flash on the display, followed by the present reading.

3.2 Alarm Conditions

When input exceeds a setpoint (SP), the meter goes into an alarm condition. During an alarm condition, the display alternates between an alarm message (Hi or Lo) and the present reading, and, if your meter has Option C, the corresponding relay is activated. The Alarm Messages which may appear during an alarm condition are listed below.

Alarm Message	Description
[Hi]	SP1H exceeded. Display flashes present reading.
[Lo]	SP1L exceeded. Display flashes present reading.
[Hi]	SP2H exceeded. Display flashes present reading.
[Lo]	SP2L exceeded. Display flashes present reading.
[Hi Hi]	SP1H and SP2H exceeded. Display flashes present reading.
[Lo Lo]	SP1L and SP2L exceeded. Display flashes present reading.
[Hi Lo]	SP1H and SP2L exceeded. Display flashes present reading.
[Lo Hi]	SP1L and SP2H exceeded. Display flashes present reading.

3.3 Setup Mode

Use the setup mode to select setpoint values, hysteresis, offset and scale values, as well as setting the decimal point (dP) position.

During Setup, values are entered into the meter's temporary memory until the Run Mode is entered at the end of the Setup cycle. At that time, temporary memory is transferred to nonvolatile memory.

IMPORTANT

(1) **Two-Minute Entry Time:**

During Setup, the meter allows ONLY 2 MINUTES between keystrokes to enter or change a parameter. If 2 minutes lapse without a keystroke, the meter automatically returns to the Run Mode and erases any temporary memory without changing nonvolatile memory.

(2) **Change setting in nonvolatile memory:**

After entering the Setup mode, press <S> until you come to the function you want to change. After changing a setup entry, press <S> again until the "run" prompt is displayed. The new value is entered into nonvolatile memory when the display goes blank.

3.3.1 Key Functions

The keys on the front panel are used to step through the Setup Program. The Setup Program is used to program setpoints and select values such as scale, offset, and hysteresis.

There are 3 keys on the front panel:

S — Used to enter Setup Mode, to scroll through setup prompts, or to enter a selection or value into temporary memory.

▲ — Used to increase a displayed value. Press and hold this key to rapidly increase the displayed value.

▼ — Used to decrease a displayed value. Press and hold this key to rapidly decrease the displayed value.

3.3.2 Setup Prompts

The following Setup Prompts appear in the display during the Setup Mode:

SETUP - This prompt tells you to enter the lockout code (28) to enter the Setup Mode.

InPuT - This prompt is followed by the actual input reading, disregarding scale, offset, and decimal point location.

SP 1H - This prompt, which is followed by the present setting, tells you to select the High Limit value of setpoint 1 (SP1H).

SP 1L - This prompt, which is followed by the present setting, tells you to select the Low Limit value of setpoint 1 (SP1L).

SP 2H - This prompt, which is followed by the present setting, tells you to select the High Limit value of setpoint 2 (SP2H).

SP 2L - This prompt, which is followed by the present setting, tells you to enter the Low Limit value of setpoint 2 (SP2L).

HYS - This prompt, which is followed by the present setting, tells you to select the Hysteresis (deadband) value. This is a number to be added to a low limit value or subtracted from a high limit value before an alarm condition is cancelled, and is common to both setpoints.

OFFSE - This prompt, which is followed by the present setting, tells you to select the Display Offset Value. This applies only if you have a Model 2820A or another model with Option F.

SCALE - This prompt, which is followed by the present value, tells you to select the Display Scale Value. This applies only if you have a Model 2820A or another model with Option F.

dP - This prompt tells you to select the decimal point position.

run - This prompt tells you that the Setup Mode is complete. Any values selected in the Setup Mode are transferred to nonvolatile memory when the meter returns to the Run Mode.

3.3.3 Sample Setup Program

The following example shows the Setup Program for a meter with Scale and Offset capabilities.

Remember: Three Front Panel Keys: <S> to start Setup, to scroll through Setup entries, and to save a selection in temporary memory; ▲ to increase a displayed value; and ▼ to decrease a displayed value.

Setup Sequence:

1. Press <S>. The display says **SETUP** followed by **0.**

2. Enter the Lock Out Code (28) using ▲ to raise the displayed value to 30, then press ▼ twice to get to 28.

3. Press <S>. The display will say **InPuT,** followed by the input reading.

4. When **SP 1H** is displayed, followed by its present setting, enter the high limit of Setpoint 1 (SP1H) by raising or lowering the displayed value and pressing <S>.

5. When **SP 1L** is displayed, followed by its present value, enter the low limit of Setpoint 1 (SP1L) by raising or lowering the displayed value and pressing <S>. Repeat these steps to set the two remaining setpoint values. NEVER set SP1L higher than SP1H or SP2L higher than SP2H.

6. When **HYS** is displayed, followed by its present value, enter the Hysteresis (deadband) by raising or lowering the displayed value and pressing <S>.

7. When **OFFSE** is displayed, followed by its present value, enter the offset value by raising or lowering the displayed value and pressing <S>.

8. When **SCALE** is displayed, followed by its present value, enter the scale value by raising or lowering the displayed value and pressing <S>.

   NOTE: Maximum scale factor factor is 3.2000.

9. When **dP** is displayed, position the blinking decimal point using the ▲ or ▼ switches and pressing <S>. If you want to stay in the Setup Mode, continue to press <S> when **run** is displayed.

10. The display will say **run** and, if you are not still holding <S>, the display will go blank (at which time the values and setpoints are entered into nonvolatile memory).

3.4 Digital Offset and Scale

Display values for offset and scale are entered during Setup. There are two methods to derive scale and offset values.

Method 1 is for use when no input is connected.

Method 2 requires that an input signal be connected.

3.4.1 Method 1

Derived from the basic formula **Y = mx + b** (where **Y** = Display, **m** = scale, **x** = input, and **b** = offset), this method shows you how to calculate scale and offset values using predicted input values.

Scale Factor

First, you must calculate the scale factor using the following formula.

$$\text{Scale (m)} = \frac{\text{Display High - Display Low}}{\text{Input High - Input Low}}$$

where:

Display High = The desired highest reading in counts (ignore decimal point)
Display Low = The desired lowest reading in counts (ignore decimal point)
Input High = The normal reading in counts (ignore decimal point) from high process input
Input Low = The normal reading in counts (ignore decimal point) from low process input

The following chart lists normal (no scale factor) display readings with associated inputs for various IQ-280A models, for use as a reference when calculating your scale factor.

Model	Shunt Resistor	Typical Low Values Input	Typical Low Values Display	Typical High Values Input	Typical High Values Display
2820A-23	---	1V	1000	5V	5000
2820A-25	---	5V	5000	10V	9999
2820A-27	50Ω	4mA	2000	20mA	9999
2820A-29	20Ω	10mA	2000	50mA	9999
2810A-10F	10Ω	4mA	0400	20mA	1999
2811A-10F	10Ω	10mA	1000	50mA	5000
2810A-03F	---	-5V	-500	5V	500
2811A-02F	---	1V	1000	10V	9999
2812A-03F	---	1V	1000	5V	5000

Offset Factor

Calculate the offset factor using the following formula.

$$\text{Offset (b)} = \text{Display Low} - (\text{Scale} \times \text{Input Low})$$

where:

Display Low = The desired lowest meter reading in counts (ignore decimal point)
Input Low = The normal meter reading in counts (ignore decimal point) from lowest process signal input

Example A

This example shows how to calculate scale and offset factors for a Model 2820A-27.

Actual Input = 4 to 20mA
Desired Display = 0 to 100.0 (the display range you want as a result of scale factor)

Now you must determine the values to be used in the formula for calculating the scale factor.

Display High = 1000 (remember to ignore the decimal point)
Display Low = 0
Input High = 9999 (actual reading without scale or offset with 20mA applied, see chart)
Input Low = 2000 (actual reading without scale or offset with 4mA applied, see chart)

Next, use these numbers in the formula . . .

$$\text{Scale (m)} = \frac{1000 - 0}{9999 - 2000} = \frac{1000}{7999} = \mathbf{0.125}$$

Calculate the offset factor using the following formula.

$$\text{Offset (b)} = \text{Display Low} - (\text{Scale} \times \text{Input Low})$$

where:

Display Low = The desired lowest meter reading in counts (ignore decimal point)
Input Low = The normal meter reading in counts (ignore decimal point) from lowest process signal input

Use the appropriate numbers in the formula for calculating the offset factor.

$$\text{Offset (b)} = 0 - (0.125 \times 2000) = 0 - 250 = -250$$

Example B

This example shows how to calculate scale and offset for a Model 2820A-27. Assume for this example that your process is to be controlled only between 6 and 10mA, even though the meter's range is 0 to 20mA.

Actual Input = 6 to 10mA
Desired Display = 0 to 400.0 (the display range you want as a result of scale factor)

Now you must determine the values to be used in the formula for calculating the scale factor.

Display High = 4000 (remember to ignore the decimal point)
Display Low = 0
Input High = 5000 (input of 10mA x 50Ω shunt = 500.0, or 5000 counts, actual reading)
Input Low = 3000 (input of 6mA x 50Ω shunt = 300.0, or 3000 counts, actual reading)

Next, use these numbers in the formula . . .

$$\text{Scale (m)} = \frac{4000 - 0}{5000 - 3000} = \frac{4000}{2000} = \mathbf{2.000}$$

Calculate the offset factor using the following formula.

$$\text{Offset (b)} = \text{Display Low} - (\text{Scale} \times \text{Input Low})$$

where:

Display Low = The desired lowest meter reading in counts (ignore decimal point)
Input Low = The normal meter reading in counts (ignore decimal point) from lowest process signal input

Use the appropriate numbers in the formula for calculating the offset factor.

$$\text{Offset (b)} = 0 - (2 \times 3000) = 0 - 6000 = -6000$$

3.4.2 Method 2

Derived from the basic formula **Y = mx + b** (where **Y** = Display, **m** = scale, **x** = input, and **b** = offset), this method shows you how to calculate scale and offset values using measured input values, with input connected.

Scale Factor

First, you must calculate the scale factor using the following formula.

$$\text{Scale (m)} = \frac{\text{Display High} - \text{Display Low}}{\text{Input High} - \text{Input Low}}$$

where:

Display High = The desired highest reading in counts (ignore decimal point)
Display Low = The desired lowest reading in counts (ignore decimal point)
Input High = The normal reading in counts (ignore decimal point) from high process input
Input Low = The normal reading in counts (ignore decimal point) from low process input

Procedure:

1. As in the Setup procedure, press the <S> key on the meter, enter the lockout code, and press <S> again. **InPUT** will be displayed.

2. Apply a zero, or Process Low, load to the transducer.

   A. Record the actual meter reading (ignore decimal point). This is the **Input Low** value.

   B. Record what you want the meter to read at this point (ignore decimal point). This is the **Display Low** value.

3. Apply a Process High load to the transducer.

   A. Record the actual meter reading (ignore decimal point). This is the **Input High** value.

   B. Record what you want the meter to read at this point (ignore decimal point). This is the **Display High** value.

4. Next, use these numbers in the formula . . .

$$\text{Scale (m)} = \frac{\text{Display High - Display Low}}{\text{Input High - Input Low}}$$

Offset Factor

Calculate the offset factor using the following formula with values derived during scale calculation.

$$\text{Offset (b)} = \text{Display Low} - (\text{Scale} \times \text{Input Low})$$

3.5 Overflow Condition

An overflow condition occurs when the meter's display range is exceeded. This is indicated by the prompt **OFLO**, which will appear in the display. Certain offset and scale adjustments can inhibit the display of **OFLO**.

Section 4 - SCHEMATICS, ASSEMBLY DRAWINGS and PARTS LISTS

IMPORTANT: Replacement of certain parts may require field or factory recalibration of the meter.

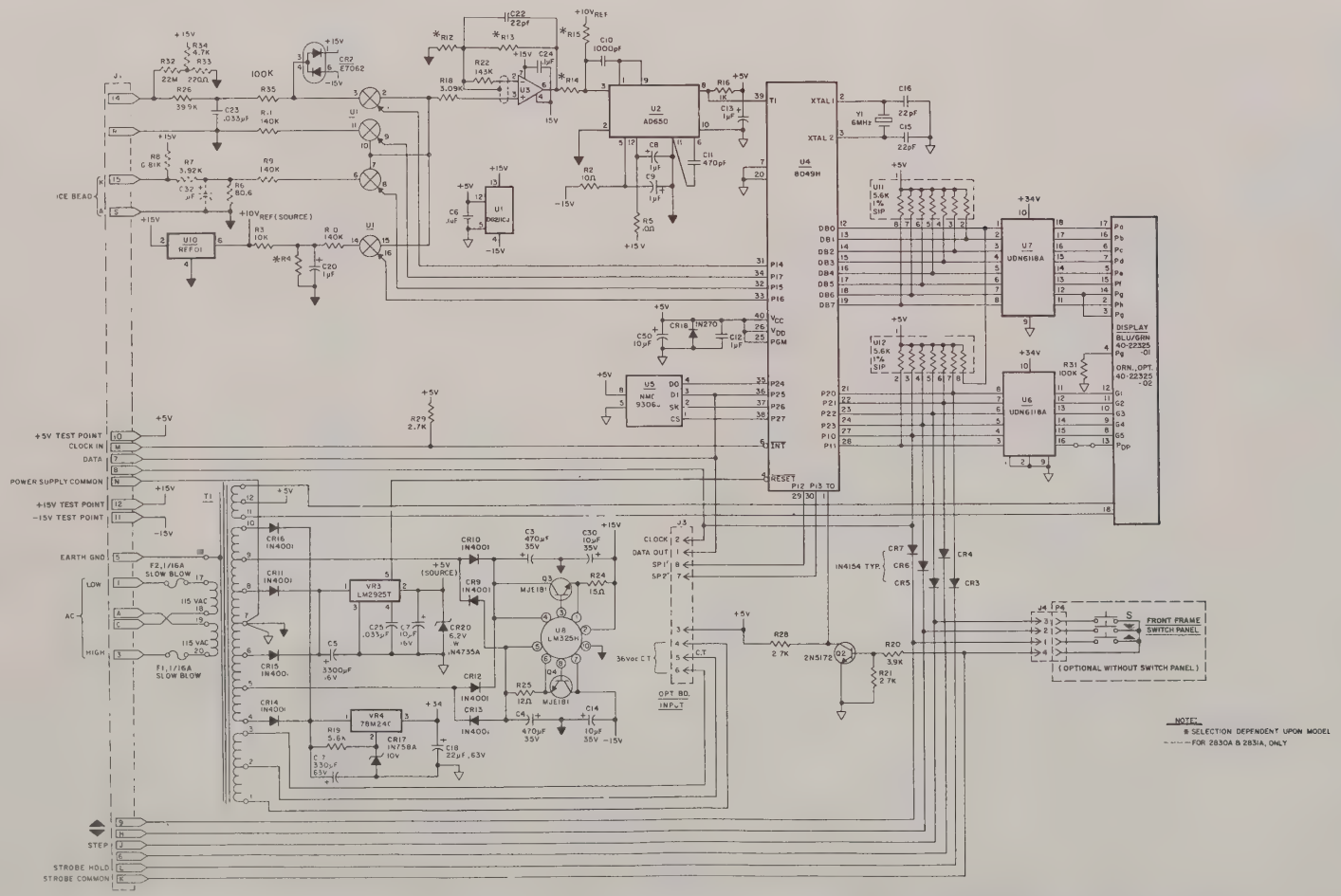


Figure 11. Main P. C. Board Schematic (Meters with Standard AC Power Supply)

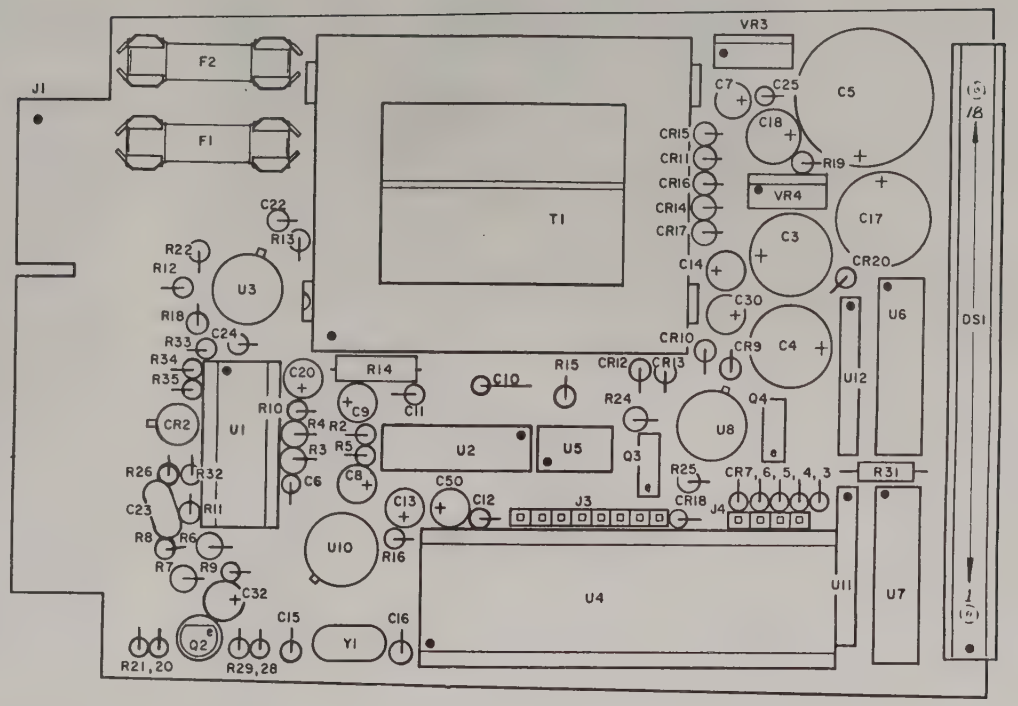


Figure 12. Main P.C. Board Assembly (Meters with Standard AC Power Supply)

Main P. C. Board Parts List (Meters with Standard AC Power Supply)

*Reference Number	Digitec P/N	Description	Vendor
C3	56-23184-477M35	Capacitor, Electro., 470µF, 35V	Nichicon, UVX
C4	56-23184-477M35	Capacitor, Electro., 470µF, 35V	Nichicon, UVX
C5	56-23184-338M16	Capacitor, Electro., 3300µF, 16V	Nichicon, UVX
C6	56-22254B104KR5	Capacitor, Ceramic, 0.1µF, 50V, 20%	Corning, Z5U
C7	56-20588-106M16	Capacitor, Electro., 10µF, 16V	Panasonic, Z
C8	56-12731B105N35	Capacitor, Tant., 1µF, 35V	Sprague, 196D
C9	56-12731B105N35	Capacitor, Tant., 1µF, 35V	Sprague, 196D
C10	56-23244B102J1	Capacitor, Cog, 1000pF, 100V, 5%	Corning, CAC02/03/04/05
C11	56-23244A471GR5	Capacitor, Cog, 470pF, 50V,2%	Corning, CAC02/03/04/05
C12	56-22254B104KR5	Capacitor, Ceramic, 0.1µF, 50V, 20%	Corning, Z5U
C13	56-12731B105N35	Capacitor, Tant., 1µF, 35V	Sprague, 196D
C14	56-20588-106M35	Capacitor, Electro., 10µF, 35V	Panasonic, Z
C15	56-23244A220JR5	Capacitor, Cog, 22pF, 50V, 5%	Corning, CAC02/03/04/05
C16	56-23244A220JR5	Capacitor, Cog, 22pF, 50V, 5%	Corning, CAC02/03/04/05
C17	56-23184-337M63	Capacitor, Electro., 330µF, 63V	Nichicon, UVX
C18	56-23184-226M63	Capacitor, Electro., 22µF, 63V	Nichicon, UVX
C20	56-12731B105N35	Capacitor, Tant., 1µF, 35V	Sprague, 196D
C22	56-23244A220JR5	Capacitor, Cog, 22pF, 50V, 5%	Corning, CAC02/03/04/05
C23	56-23273D333K2	Capacitor, Ceramic, 0.033µF, 200V, 20%	Murata Erie, RPE
C24	56-22254B104KR5	Capacitor, Ceramic, 0.1µF, 50V, 20%	Corning, Z5U
C25	56-22254A333KR5	Capacitor, Ceramic, 0.033µF, 50V, 20%	Corning, Z5U
C30	56-20588-106M35	Capacitor, Electro., 10µF, 35V	Panasonic, Z
C32	56-12731B105N35	Capacitor, Tant., 1µF, 35V	Sprague, 196D
C50	56-20588-106M16	Capacitor, Electro., 10µF, 16V	Panasonic, Z
CR2	40-16800	Diode, Dual Low Leakage, E7062	Siliconix
CR3	40-09297	Diode, Signal, 1N4154	Motorola
CR4	40-09297	Diode, Signal, 1N4154	Motorola
CR5	40-09297	Diode, Signal, 1N4154	Motorola

* Reference Number is found on the corresponding assembly drawing.

Main P. C. Board Parts List (Meters with Standard AC Power Supply, cont.)

*Reference Number	Digitec P/N	Description	Vendor
CR6	40-09297	Diode, Signal, 1N4154	Motorola
CR7	40-09297	Diode, Signal, 1N4154	Motorola
CR9	40-07787-01	Diode, Power, 1N4001	ITT
CR10	40-07787-01	Diode, Power, 1N4001	ITT
CR11	40-07787-01	Diode, Power, 1N4001	ITT
CR12	40-07787-01	Diode, Power, 1N4001	ITT
CR13	40-07787-01	Diode, Power, 1N4001	ITT
CR14	40-07787-01	Diode, Power, 1N4001	ITT
CR15	40-07787-01	Diode, Power, 1N4001	ITT
CR16	40-07787-01	Diode, Power, 1N4001	ITT
CR17	40-22691	Diode, Zener, 10V, 1N758A	Fairchild
CR18	40-20298	Diode, Signal, 1N270	ITT
CR20	40-23152-35	Diode, Zener, 6.2V, 1W, 1N4735A	Motorola
DS1	40-22325-01	Display, Blue/Green	Digitec
F1	52-23333-05	Fuse, Type FTR, Slo-Blo, 1/16 Amp	Schurter
F2	52-23333-05	Fuse, Type FTR, Slo-Blo, 1/16 Amp	Schurter
Q2	40-11353	Transistor, NPN, Signal, 2N5172	GE
Q3	40-23118	Transistor, NPN, Power, MJE181	Motorola
Q4	40-23118	Transistor, NPN, Power, MJE181	Motorola
R2	55-10101HA010	Resistor, C. C., 10 Ohm, 1/4W, 5%	IRC, GBT 1/4
R3	55-22443DDK010	Resistor, M. F., 10K Ohm, 1/8W, .5%	TRW, MAR 6
R4	55-22443DDA205	Resistor, M. F., 205 Ohm, 1/8W, .5% (2810A/12A)	TRW, MAR 6
R4	55-22443DDA102	Resistor, M. F., 102 Ohm, 1/8W, .5% (2811A-00)	TRW, MAR 6
**R4	55-22443DDK001R1	Resistor, M. F., 1.1K Ohm, 1/8W, .5%	TRW, MAR 6
R5	55-10101HA010	Resistor, C. C., 10 Ohm, 1/4W, 5%	IRC, GBT 1/4
R9	55-10168ELK140	Resistor, F. F., 140K Ohm, 1/8W, 1%	Dale, MFF
R10	55-10168ELK140	Resistor, F. F., 140K Ohm, 1/8W, 1%	Dale, MFF

* Reference Number is found on the corresponding assembly drawing.
** Used on all 2820A models and all 2811A models except 2811A-00.

Main P. C. Board Parts List (Meters with Standard AC Power Supply, cont.)

*Reference Number	Digitec P/N	Description	Vendor
R11	55-10168ELK140	Resistor, F. F., 140K Ohm, 1/8W, 1%	Dale, MFF
R12	55-22443DDA205	Resistor, M. F., 205 Ohm, 1/8W, .5% (2810A/12A)	TRW, MAR 6
R12	55-22443DDA102	Resistor, M. F., 102 Ohm, 1/8W, .5% (2811A-00)	TRW, MAR 6
**R12	55-22443DDK001R1	Resistor, M. F., 1.1K Ohm, 1/8W, .5%	TRW, MAR 6
R13	55-22443DDK004R92	Resistor, M. F., 4.92K Ohm, 1/8W .5% (2810A/12A)	TRW, MAR 6
R13	55-22443DDK004R99	Resistor, M. F., 4.99K Ohm, 1/8W, .5% (2811A-00)	TRW, MAR 6
**R13	55-22443DDK004R42	Resistor, M. F., 4.42K Ohm, 1/8W, .5%	TRW, MAR 6
R14	55-23441DDK028R7	Resistor, M. F., 28.7K Ohm, 1/10W, .5%	TRW, MAR 6
R15	55-22443DDK051R1	Resistor, M. F., 51.1K Ohm, 1/8W, .5%	TRW, MAR 6
R16	55-10101HK001	Resistor, C. C., 1K Ohm, 1/4W, 5%	IRC, GBT 1/4
R18	55-10168ELK003R09	Resistor, F. F., 3.09K Ohm, 1/8W, 1%	Dale, MFF
R19	55-10101HK005R6	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R20	55-10101HK003R9	Resistor, C. C., 3.9K Ohm, 1/4W, 5%	IRC, GBT 1/4
R21	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R22	55-10168ELK143	Resistor, F. F., 143K Ohm, 1/8W, 1%	Dale, MFF
R24	55-10101HA015	Resistor, C. C., 15 Ohm, 1/4W, 5%	IRC, GBT 1/4
R25	55-10101HA012	Resistor, C. C., 12 Ohm, 1/4W, 5%	IRC, GBT 1/4
R26	55-10168ELK039R9	Resistor, F. F., 39.9K Ohm, 1/8W, 1%	Dale, MFF
R28	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R29	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R31	55-10101HK100	Resistor, C. C., 100K Ohm, 1/4W, 5%	IRC, GBT 1/4
R35	55-10168ELK100	Resistor, F. F., 100K Ohm, 1/8W, 1%	Dale, MFF
T1	42-23080	Transformer	Digitec
U1	40-22328	IC, Analog Switch, DG211CJ	Siliconix
U2	40-22196	IC, Voltage/Frequency Converter, AD650JN	Analog Devices
U3	40-23227-01	IC, Op-Amp, OPA111AM	Burr-Brown
U4	07-22570	PROM, Programmed	Digitec

* Reference Number is found on the corresponding assembly drawing.
** Used on all 2820A models and all 2811A models except 2811A-00.

Main P. C. Board Parts List (Meters with Standard AC Power Supply, cont.)

*Reference Number	Digitec P/N	Description	Vendor
U5	40-22324	IC, Programmable, Memory	Not User Replaceable
U6	40-22327	IC, Display Driver, UDN6118A	Sprague
U7	40-22327	IC, Display Driver, UDN6118A	Sprague
U8	40-23153	IC, DPTR, ±15V, LM325H	National Semiconductor
U10	40-23238-02	IC, Voltage Reference, REF01EJ	Precision Monolithics
U11	55-22366FJK005R6	Resistor Module, 8 Pin SIP, 5.6K Ohm	Bourns
U12	55-22366FJK005R6	Resistor Module, 8 Pin SIP, 5.6K Ohm	Bourns
VR3	40-23079	Regulator, +5V w/Reset, LM2925T	National Semiconductor
VR4	40-16079	Regulator, +24V, 78M24C	Motorola
Y1	40-19735-10	Crystal, 6 MHz	M-Tron

* Reference Number is found on the corresponding assembly drawing.
** Used on all 2820A models and all 2811A models except 2811A-00.

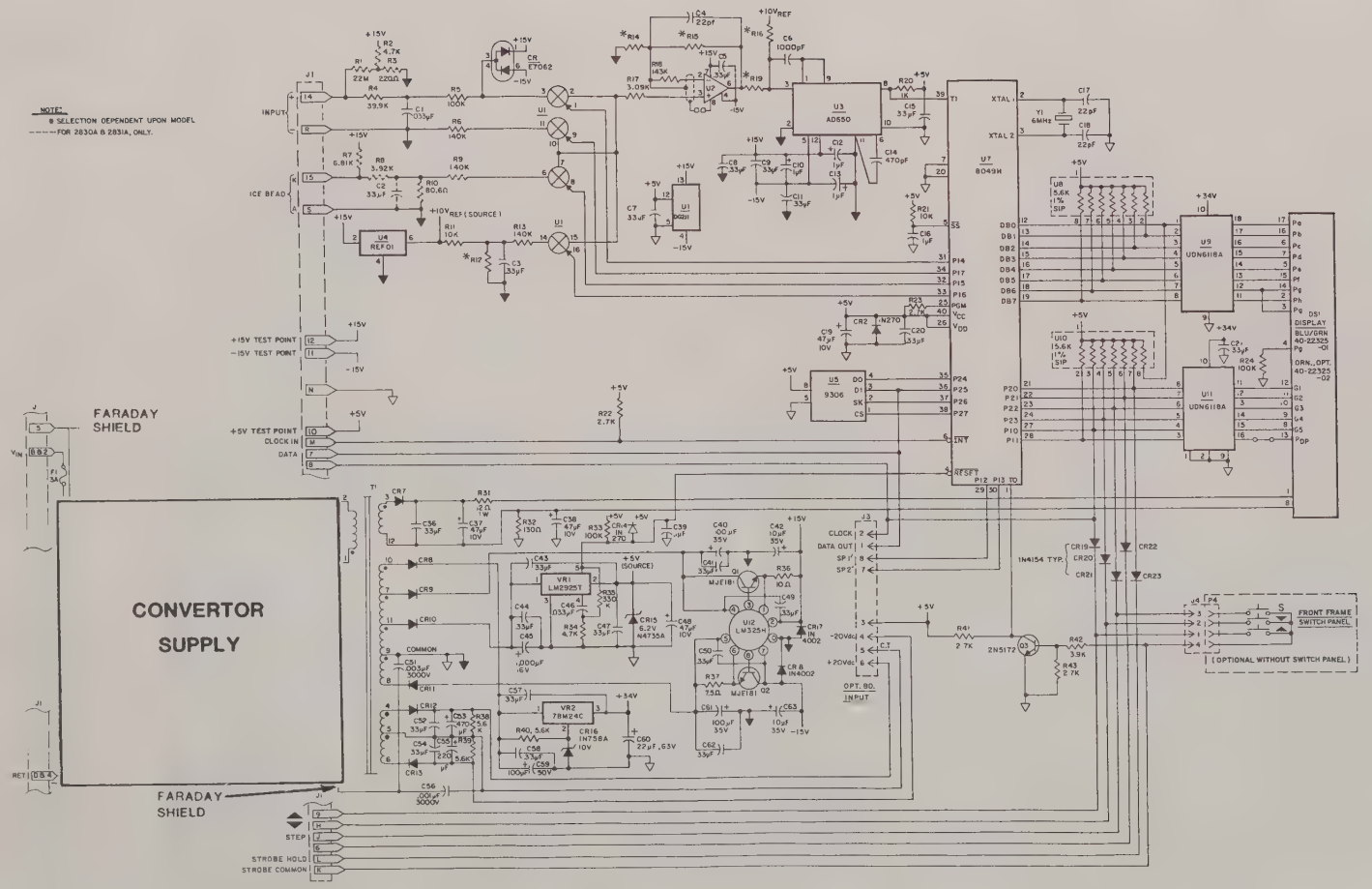


Figure 13. Main P. C. Board Schematic (Meters with Optional DC Power Supply)

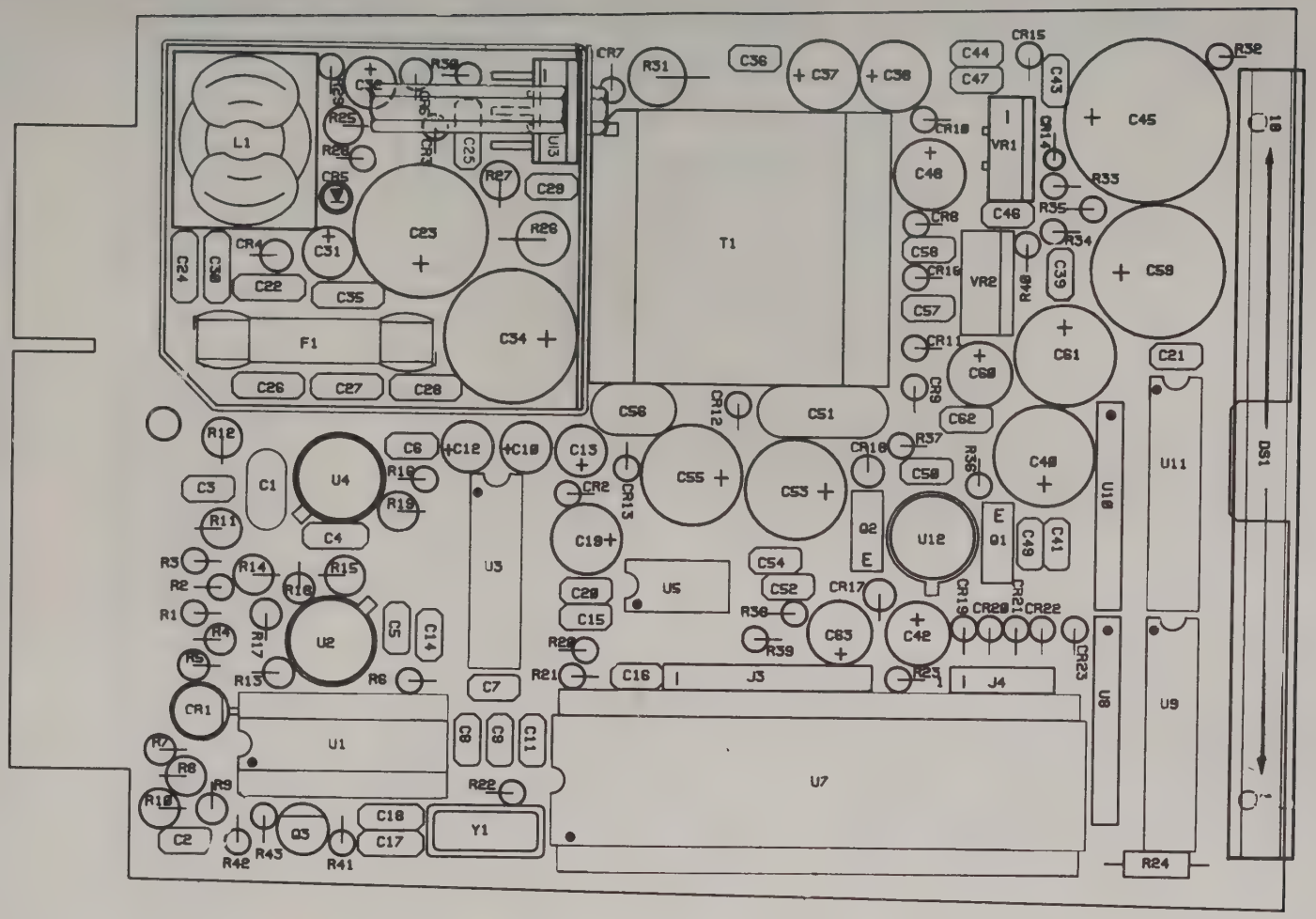


Figure 14. Main P.C. Board Assembly (Meters with Optional DC Power Supply)

Main P. C. Board Parts List (Meters with Optional DC Power Supply)

*Reference Number	Digitec P/N	Description	Vendor
C1	56-23273D333K2	Capacitor, Ceramic, 0.033 ™F, 200V, 20%	Murata Erie, RPE
C3	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C4	56-10210K220HP3	Capacitor, MICA, 22pF, 300V	ADI
C5	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C6	56-23700B102J1	Capacitor, Cog, 1000pF, 100V, 5%	Murata Erie, RPE
C7	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C8	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C9	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C10	56-12731B105N35	Capacitor, Tant., 1 ™F, 35V	Sprague, 196D
C11	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C12	56-12731B105N35	Capacitor, Tant., 1 ™F, 35V	Sprague, 196D
C13	56-12731B105N35	Capacitor, Tant., 1 ™F, 35V	Sprague, 196D
C14	56-23700B471G1	Capacitor, Cog, 470pF, 100V, 2%	Murata Erie, RPE
C15	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C16	56-23699C104MR5	Capacitor, Ceramic, .1 ™F, 50V, 20%	Sprague, Z5U
C17	56-10210K220HP3	Capacitor, MICA, 22pF, 300V	ADI
C18	56-10210K220HP3	Capacitor, MICA, 22pF, 300V	ADI
C19	56-12731E476N10	Capacitor, Tant., 47 ™F, 10V, 20%	Sprague, 196D
C20	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C21	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C36	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C37	56-12731E476N10	Capacitor, Tant., 47 ™F, 10V, 20%	Sprague, 196D
C38	56-12731E476N10	Capacitor, Tant., 47 ™F, 10V, 20%	Sprague, 196D
C39	56-23699C104MR5	Capacitor, Ceramic, .1 ™F, 50V, 20%	Sprague, Z5U
C40	56-23673-107M35	Capacitor, Electro, 100 ™F, 35V, 20%	Nichicon
C41	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C42	56-20588-106M35	Capacitor, Electro., 10 ™F, 35V, 20%	Panasonic, Z
C43	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C44	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C45	56-23673-108M16	Capacitor, Electro, 1000 ™F, 16V, 20%	Nichicon

* Reference Number is found on the corresponding assembly drawing.

Main P. C. Board Parts List (Meters with Optional DC Power Supply, cont.)

*Reference Number	Digitec P/N	Description	Vendor
C46	56-23273C333KR5	Capacitor, Ceramic, 0.033 ™F, 50V, 20%	Murata Erie, RPE
C47	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C48	56-12731E476N10	Capacitor, Tant., 47 ™F, 10V, 20%	Sprague, 196D
C49	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C50	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C51	56-23735H332MA30	Capacitor, Ceramic, .0033 ™F, 3000V, 20%	Murata Erie, RPE
C52	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C53	56-23184-477M35	Capacitor, Electro., 470 ™F, 35V, 20%	Nichicon, UVX
C54	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C55	56-23184-227M35	Capacitor, Electro., 220 ™F, 35V, 20%	Nichicon, UVX
C56	56-23735E102MA30	Capacitor, Ceramic, .001 ™F, 3000V, 20%	Murata Erie, RPE
C57	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C58	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C59	56-23673-107M50	Capacitor, Electro, 100 ™F, 50V, 20%	Nichicon
C60	56-23184-226M63	Capacitor, Electro., 22 ™F, 63V	Nichicon, UVX
C61	56-23673-107M35	Capacitor, Electro, 100 ™F, 35V, 20%	Nichicon
C62	56-23699D334MR5	Capacitor, Ceramic, .33 ™F, 50V, 20%	Sprague, Z5U
C63	56-20588-106M35	Capacitor, Electro., 10 ™F, 35V, 20%	Panasonic, Z
CR1	40-16800	Diode, Dual Low Leakage, E7062	Siliconix
CR2	40-20298	Diode, Signal, 1N270	ITT
CR7	40-23664-02	Diode, Power, MUR 110	Motorola
CR8	40-23664-02	Diode, Power, MUR 110	Motorola
CR9	40-23664-02	Diode, Power, MUR 110	Motorola
CR10	40-23664-02	Diode, Power, MUR 110	Motorola
CR11	40-23664-02	Diode, Power, MUR 110	Motorola
CR12	40-23664-02	Diode, Power, MUR 110	Motorola
CR13	40-23664-02	Diode, Power, MUR 110	Motorola
CR14	40-20298	Diode, Signal, 1N270	ITT
CR15	40-23152-35	Diode, Zener, 6.2V, 1W, 1N4735A	Motorola
CR16	40-22691	Diode, Zener, 10V, 1N758A	Fairchild

* Reference Number is found on the corresponding assembly drawing.

Main P. C. Board Parts List (Meters with Optional DC Power Supply, cont.)

*Reference Number	Digitec P/N	Description	Vendor
CR17	40-07787-02	Diode, Power, 1N4002	ITT
CR18	40-07787-02	Diode, Power, 1N4002	ITT
CR19	40-09297	Diode, Signal, 1N4154	Motorola
CR20	40-09297	Diode, Signal, 1N4154	Motorola
CR21	40-09297	Diode, Signal, 1N4154	Motorola
CR22	40-09297	Diode, Signal, 1N4154	Motorola
CR23	40-09297	Diode, Signal, 1N4154	Motorola
DS1	40-22325-01	Display, Blue/Green	Digitec
F1	52-23668-26	Fuse, 5 x 20mm, 3 Amp	Bel
J3	51-15204-08	Header, Straight, Modified 8-Pin	Digitec
J4	51-15204-04	Header, Straight, Modified 4-Pin	Digitec
Q1	40-23118	Transistor, NPN, Power, MJE181	Motorola
Q2	40-23118	Transistor, NPN, Power, MJE181	Motorola
Q3	40-11353	Transistor, NPN, Signal, 2N5172	GE
R4	55-10168ELK039R9	Resistor, F. F., 39.9K Ohm, 1/8W, 1%	Dale, MFF
R5	55-10168ELK100	Resistor, F. F., 100K Ohm, 1/8W, 1%	Dale, MFF
R6	55-10168ELK140	Resistor, F. F., 140K Ohm, 1/8W, 1%	Dale, MFF
R11	55-22443DDK010	Resistor, M. F., 10K Ohm, 1/8W, .5%	TRW, MAR 6
R12	55-22443DDA205	Resistor, M. F., 205 Ohm, 1/8W, .5% (2810AR and 2812AR)	TRW, MAR 6
R12	55-22443DDK001R1	Resistor, M. F., 1.1K Ohm, 1/8W, .5% (2811AR and 2820AR)	TRW, MAR 6
R13	55-10168ELK140	Resistor, F. F., 140K Ohm, 1/8W, 1%	Dale, MFF
R14	55-22443DDA205	Resistor, M. F., 205 Ohm, 1/8W, .5% (2810AR and 2812AR)	TRW, MAR 6
R14	55-22443DDK001R1	Resistor, M. F., 1.1K Ohm, 1/8W, .5% (2811AR and 2820AR)	TRW, MAR 6
R15	55-22443DDK004R92	Resistor, M. F., 4.92K Ohm, 1/8W .5% (2810AR and 2812AR)	TRW, MAR 6
R15	55-22443DDK004R42	Resistor, M. F., 4.42K Ohm, 1/8W, .5% (2811AR and 2820AR)	TRW, MAR 6
R16	55-22443DDK051R1	Resistor, M. F., 51.1K Ohm, 1/8W, .5%	TRW, MAR 6
R17	55-10168ELK003R09	Resistor, F. F., 3.09K Ohm, 1/8W, 1%	Dale, MFF
R18	55-10168ELK143	Resistor, F. F., 143K Ohm, 1/8W, 1%	Dale, MFF
R19	55-23441DDK028R7	Resistor, M. F., 28.7K Ohm, 1/10W, .5%	TRW, MAR 6
R20	55-10101HK001	Resistor, C. C., 1K Ohm, 1/4W, 5%	IRC, GBT 1/4

* Reference Number is found on the corresponding assembly drawing.

Main P. C. Board Parts List (Meters with Optional DC Power Supply, cont.)

*Reference Number	Digitec P/N	Description	Vendor
R31	55-10101HK010	Resistor, C. C., 10K Ohm, 1/4W, 5%	IRC, GBT 1/4
R22	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R23	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R24	55-10101HK100	Resistor, C. C., 100K Ohm, 1/4W, 5%	IRC, GBT 1/4
R31	55-10103HA012	Resistor, C. C., 12 Ohm, 1W, 5%	Ohmite
R32	55-10101HA130	Resistor, C. C., 130 Ohm, 1/4W, 5%	IRC, GBT 1/4
R33	55-10101HK100	Resistor, C. C., 100K Ohm, 1/4W, 5%	IRC, GBT 1/4
R34	55-10101HK004R7	Resistor, C. C., 4.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R35	55-10101HK330	Resistor, C. C., 330K Ohm, 1/4W, 5%	IRC, GBT 1/4
R36	55-10101HA010	Resistor, C. C., 10 Ohm, 1/4W, 5%	IRC, GBT 1/4
R37	55-10101HA007R5	Resistor, C. C., 7.5 Ohm, 1/4W, 5%	IRC, GBT 1/4
R38	55-10101HK005R6	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R39	55-10101HK005R6	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R40	55-10101HK005R6	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R41	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R42	55-10101HK003R9	Resistor, C. C., 3.9K Ohm, 1/4W, 5%	IRC, GBT 1/4
R43	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
T1	42-23669	Transformer, DC-DC, 40KHz	Digitec
U1	40-22328	IC, Analog Switch, DG211CJ	Siliconix
U2	40-23227-01	IC, Op-Amp, OPA111AM	Burr-Brown
U3	40-22196	IC, Voltage/Frequency Converter, AD650JN	Analog Devices
U4	40-23238-02	IC, Voltage Reference, REF01EJ	Precision Monolithics
U5	40-22324	IC, Programmable, Memory	Not User Replaceable
U7	07-22570	PROM, Programmed	Digitec
U8	55-22366FJK005R6	Resistor Module, 8 Pin SIP, 5.6K Ohm	Bourns
U9	40-22327	IC, Display Driver, UDN6118A	Sprague
U10	55-22366FJK005R6	Resistor Module, 8 Pin SIP, 5.6K Ohm	Bourns
U11	40-22327	IC, Display Driver, UDN6118A	Sprague
U12	40-23153	IC, DPTR, !15V, LM325H	National Semiconductor
VR1	40-23079	Regulator, +5V w/Reset, LM2925T	National Semiconductor

* Reference Number is found on the corresponding assembly drawing.

Main P. C. Board Parts List (Meters with Optional DC Power Supply, cont.)

*Reference Number	Digitec P/N	Description	Vendor
VR2	40-16079	Regulator, +24V, 78M24C	Motorola
Y1	40-19735-10	Crystal, 6 MHz	M-Tron
CR16	40-23664-02	Diode, Power, MUR 110	Motorola

* Reference Number is found on the corresponding assembly drawing.

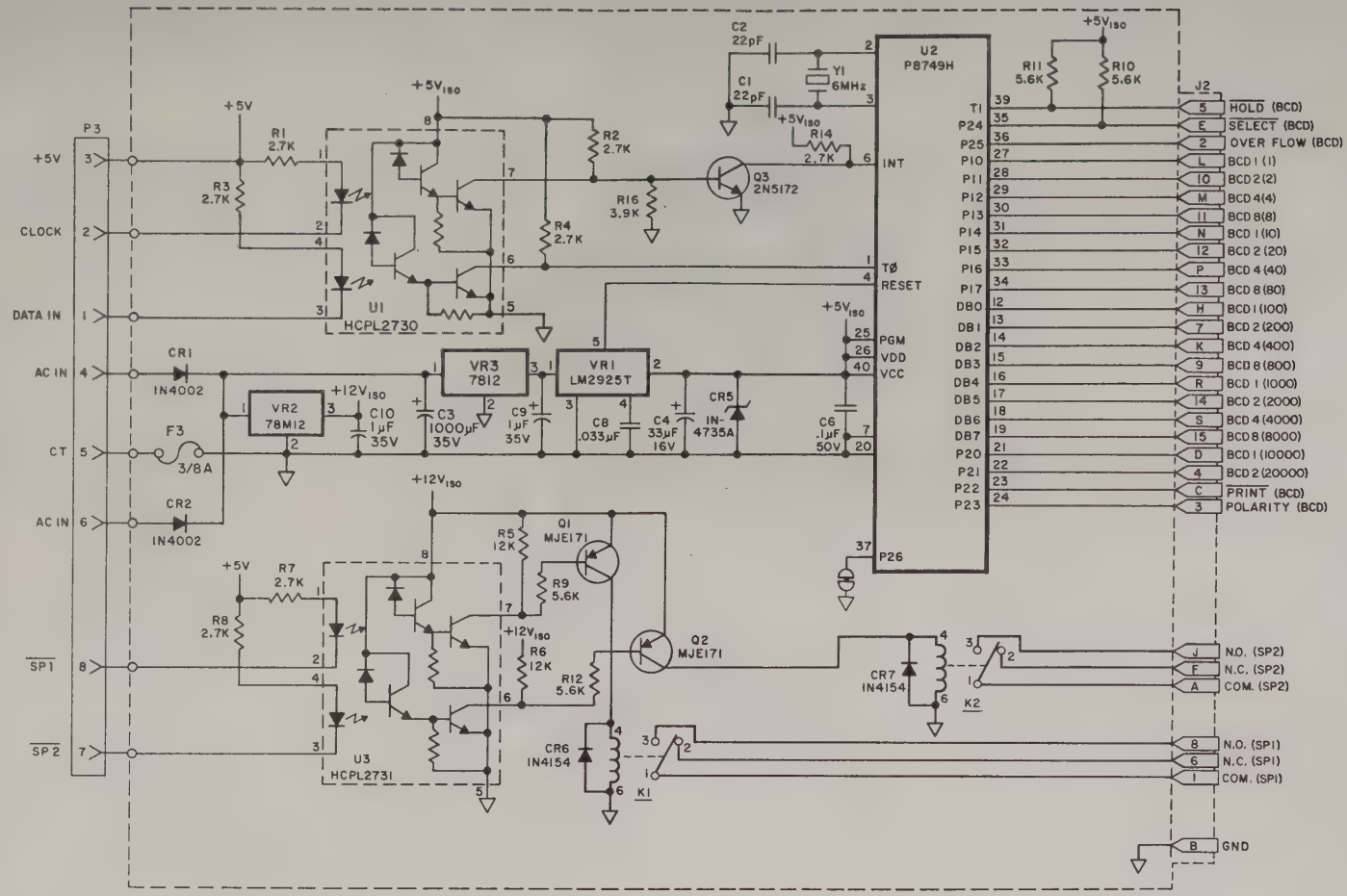


Figure 15. E, C Option Board Schematic

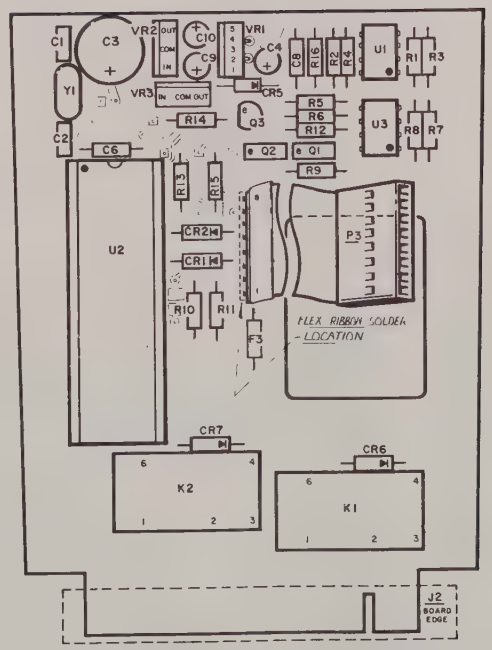


Figure 16. E, C Option Board Assembly

E, C Option Board Parts List

*Reference Number	Digitec P/N	Description	Vendor
	01-2800A-E	Complete Board Assy. For Option E	Digitec
	01-2800A-C	Complete Board Assy. For Option C	Digitec
	01-2800A-EC	Complete Board Assy. For Option EC	Digitec
C1	56-23244A220JR5	Capacitor, Cog, 22pF, 50V	Corning, CAC02/03/04/05
C2	56-23244A220JR5	Capacitor, Cog, 22pF, 50V	Corning, CAC02/03/04/05
C3	56-23184-108M35	Capacitor, Electro., 1000µF, 35V	Nichicon, UVX
C4	56-23184-336M16	Capacitor, Electro., 33µF, 16V	Nichicon, UVX
C6	56-22254B104KR5	Capacitor, Ceramic, 1µF, 50V	Corning, Z5U
C8	56-22254B333KR5	Capacitor, Ceramic, 0.033µF, 50V	Corning, Z5U
C9	56-12731B105N35	Capacitor, Tant., 1µF, 35V	Sprague, 196D
C10	56-12731B105N35	Capacitor, Tant., 1µF, 35V	Sprague, 196D
CR1	40-07787-02	Diode, Power, 1N4001	ITT
CR2	40-07787-02	Diode, Power, 1N4001	ITT
CR5	40-23152-35	Diode, Zener, 6.2V, 1W, 1N4735A	Motorola
CR6	40-09297	Diode, Signal, 1N4154	Motorola
CR7	40-09297	Diode, Signal, 1N4154	Motorola
F3	52-17936-04	Fuse, 375mA, Picofuse	Little Fuse, 275.062
K1	45-23124	Relay, Power, NB1DC12V	Aromat
K2	45-23124	Relay, Power, NB1DC12V	Aromat
P3	53-23089	Cable, Flex	T and B, Flexpac
Q1	40-23116	Transistor, PNP, Power, MJE171	Motorola
Q2	40-23116	Transistor, PNP, Power, MJE171	Motorola
Q3	40-11353	Transistor, NPN, Signal, 2N5172	GE
R1	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4
R2	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4
R3	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4
R4	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4

* Reference Number is found on the corresponding assembly drawing.

E, C Option Board Parts List (cont.)

*Reference Number	Digitec P/N	Description	Vendor
R5	55-10101HK012	Resistor, C. C., 12K Ohm, 1/4W, 5%	IRC, GTB 1/4
R6	55-10101HK012	Resistor, C. C., 12K Ohm, 1/4W, 5%	IRC, GTB 1/4
R7	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4
R8	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4
R9	55-10101HK005R6	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GTB 1/4
R10	55-10101HK005R6	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GTB 1/4
R11	55-10101HK005R6	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GTB 1/4
R12	55-10101HK005R6	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GTB 1/4
R14	55-10101HK002R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4
R16	55-10101HK003R9	Resistor, C. C., 3.9K Ohm, 1/4W, 5%	IRC, GTB 1/4
U1	40-18745	IC, Opto-Isolator, HCPL2730	Hewlett-Packard
U2	07-23416	Microcomputer, Programmed	Digitec
U3	40-23150	IC, Opto-Isolator, HCPL2731	Hewlett-Packard
VR1	40-23079	Regulator, +5V w/Reset, LM2925T	National
VR2	40-16082	Regulator, +12V, 78M12	Motorola
VR3	40-18203	Regulator, +12V, MC7812CT	Motorola
Y1	40-19735-10	Crystal, 6 MHz	M-Tron

* Reference Number is found on the corresponding assembly drawing.

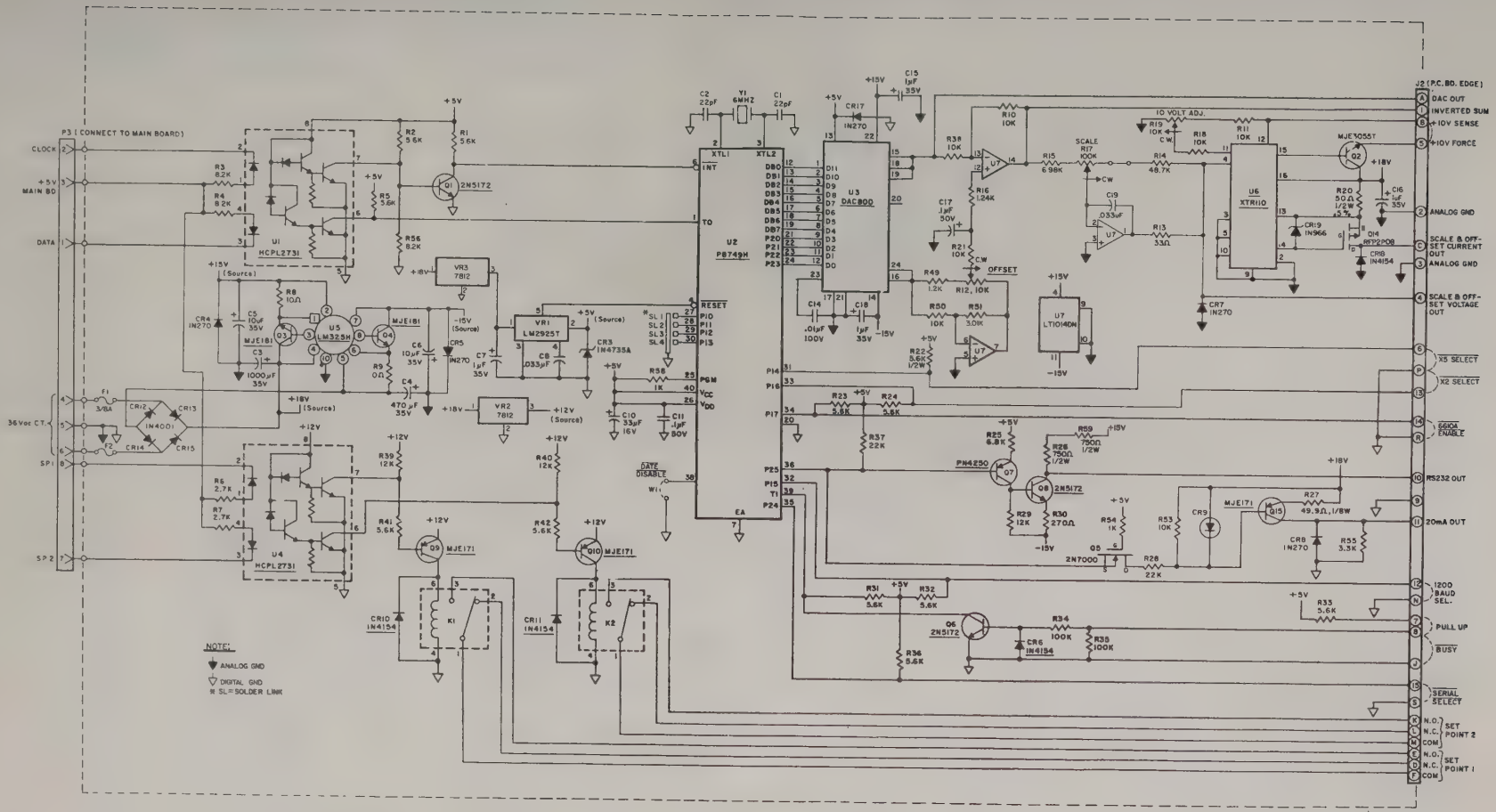


Figure 17. H, T, C Option Board Schematic

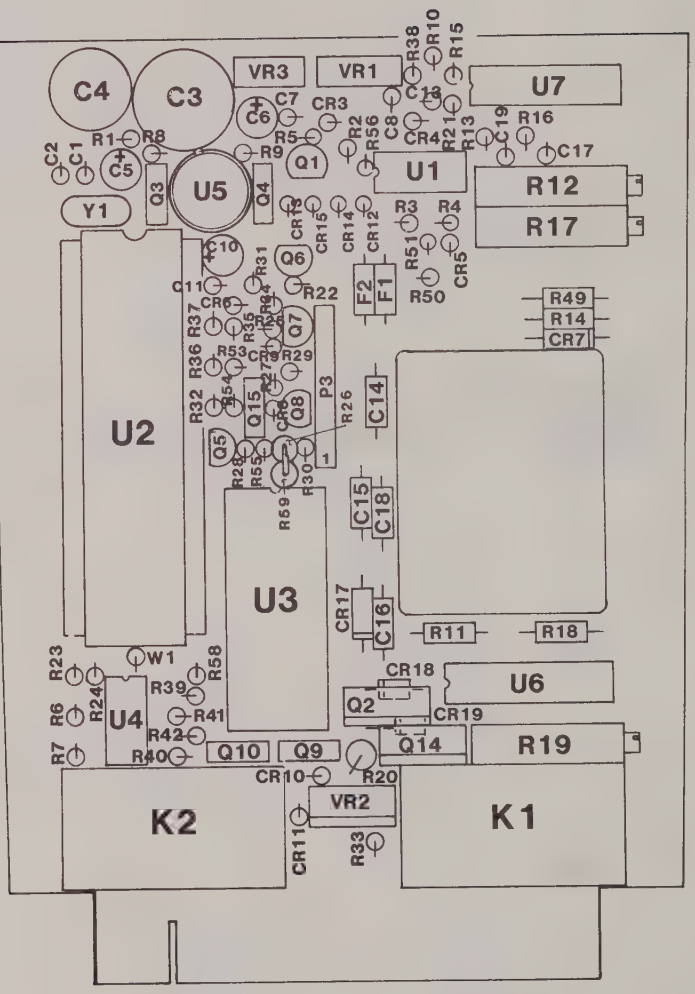


Figure 18. H, T, C Option Board Assembly

HTC Option Board Parts List

*Reference Number	Digitec P/N	Description	Vendor
	01-2800A-H	Complete Board Assy. For Option H	Digitec
	01-2800A-T	Complete Board Assy. For Option T	Digitec
	01-2800A-HT	Complete Board Assy. For Option HT	Digitec
	01-2800A-HC	Complete Board Assy. For Option HC	Digitec
	01-2800A-TC	Complete Board Assy. For Option TC	Digitec
	01-2800A-HTC	Complete Board Assy. For Option HTC	Digitec
C1	56-10210K220HP3	Capacitor, MICA, 22pF, 300V	ADI
C2	56-10210K220HP3	Capacitor, MICA, 22pF, 300V	ADI
C3	56-23184-108M35	Capacitor, Electro., 1000µF, 35V	Nichicon
C4	56-23184-477M35	Capacitor, Electro., 470µF, 35V	Nichicon
C5	56-23184-106M35	Capacitor, Electro., 10µF, 35V	Nichicon
C6	56-23184-106M35	Capacitor, Electro., 10µF, 35V	Nichicon
C7	56-23151B105M35	Capacitor, Tant., 1µF, 35V	Kemet
C8	56-22254B333KR5	Capacitor, Ceramic, 0.033µF, 50V, 20%	Corning
C10	56-23184-336M16	Capacitor, Electro., 33µF, 16V	Nichicon
C11	56-22254B104KR5	Capacitor, Ceramic, 0.1µF, 50V, 20%	Corning
C14	56-22254A103K1	Capacitor, Ceramic, 0.01µF, 100V, 20%	Corning
C15	56-23151B105M35	Capacitor, Tant., 1µF, 35V	Kemet
C16	56-23151B105M35	Capacitor, Tant., 1µF, 35V	Kemet
C17	56-22254B104KR5	Capacitor, Ceramic, 0.1µF, 50V, 20%	Corning
C18	56-23151B105M35	Capacitor, Tant., 1µF, 35V	Kemet
C19	56-22254B333KR5	Capacitor, Ceramic, 0.033µF, 50V,	Corning
CR3	40-23152-35	Diode, Zener, 6.2V, 1W, 1N4735A	Motorola
CR4	40-20298	Diode, Signal, 1N270	ITT
CR5	40-20298	Diode, Signal, 1N270	ITT
CR6	40-09297	Diode, Signal, 1N4154	Motorola
CR7	40-20298	Diode, Signal, 1N270	ITT
CR8	40-20298	Diode, Signal, 1N270	ITT

* Reference Number can be found on the corresponding assembly drawing.

HTC Option Board Parts List (cont.)

*Reference Number	Digitec P/N	Description	Vendor
CR9	40-23194	Diode, LED, HLMP1520	Hewlett-Packard
CR10	40-09297	Diode, Signal, 1N4154	Motorola
CR11	40-09297	Diode, Signal, 1N4154	Motorola
CR12	40-07787-01	Diode, Power, 1N4001	Diodes, Inc.
CR13	40-07787-01	Diode, Power, 1N4001	Diodes, Inc.
CR14	40-07787-01	Diode, Power, 1N4001	Diodes, Inc.
CR15	40-07787-01	Diode, Power, 1N4001	Diodes, Inc.
CR17	40-20298	Diode, Signal, 1N270	ITT
CR18	40-09297	Diode, Signal, 1N4154	Motorola
CR19	40-22777	Diode, Zener, 1N966	Motorola
F1	52-17936-04	Fuse, 3/8 Amp	Little Fuse
F2	52-17936-04	Fuse, 3/8 Amp	Little Fuse
K1	45-23124	Relay, Power, NB1DC12V	Aromat
K2	45-23124	Relay, Power, NB1DC12V	Aromat
P3	53-23089	Cable, Flex	T and B
Q1	40-11353	Transistor, NPN, Signal, 2N5172	GE
Q2	40-23432	Transistor, NPN, Power, MJE3055T	Motorola
Q3	40-23118	Transistor, NPN, Power, MJE181	Motorola
Q4	40-23118	Transistor, NPN, Power, MJE181	Motorola
Q5	40-23205	Transistor, FET, P-Chan., 2N7000	Siliconix
Q6	40-11353	Transistor, NPN, Signal, 2N5172	GE
Q7	40-09952	Transistor, PNP, Signal, PN4250	National
Q8	40-11353	Transistor, NPN, Signal, 2N5172	GE
Q9	40-23116	Transistor, PNP, Power, MJE171	Motorola
Q10	40-23116	Transistor, PNP, Power, MJE171	Motorola
Q14	40-23190	Transistor, Power, MOSFET, RFP2P08	RCA
Q15	40-23116	Transistor, PNP, Power, MJE171	Motorola
R1	55-10101HK005R6	Resistor, C.C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R2	55-10101HK005R6	Resistor, C.C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4

* Reference Number can be found on the corresponding assembly drawing.

HTC Option Board Parts List (cont.)

*Reference Number	Digitec P/N	Description	Vendor
R3	55-10101HK008R2	Resistor, C.C., 8.2K Ohm, 1/4W. 5%	IRC, GBT 1/4
R4	55-10101HK008R2	Resistor, C.C., 8.2K Ohm, 1/4W. 5%	IRC, GBT 1/4
R5	55-10101HK005R6	Resistor, C.C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R6	55-10101HK002R7	Resistor, C.C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R7	55-10101HK002R7	Resistor, C.C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R8	55-10101HA010	Resistor, C.C., 10 Ohm, 1/4W, 5%	IRC, GBT 1/4
R9	50-07657	Jumper, Zero Ohm	National
R10	55-23441DEK010	Resistor, F.F., 10K Ohm, 1/10W, 0.5%	PRP
R11	55-10168DDGK010	Resistor, F.F., 10K Ohm, 1/8W, 0.5%	Dale
R12	41-23237-103	Potentiometer, 10K, 30-Turn	Bourns
R13	55-10101HA033	Resistor, C.C., 33 Ohm, 1/4W, 5%	IRC, GBT 1/4
R14	55-23441DEK048R7	Resistor, M.F., 48.7K Ohm, 1/10W, 0.5%	PRP
R15	55-23441DEK006R98	Resistor, F.F., 6.98K Ohm, 1/10W, 0.5%	PRP
R16	55-10168ELK001R24	Resistor, F.F., 1.24K Ohm, 1/8W, 1%	Dale
R17	41-23462-104	Potentiometer, 100K, 30-Turn	Bourns
R18	55-10168DDGK010	Resistor, F.F., 10K Ohm, 1/8W, 0.5%	Dale
R19	41-23237-103	Potentiometer, 10K, 30-Turn	Bourns
R20	55-10119DBA050	Resistor, Wire Wound, 50 Ohm, 1/2W, 0.5%	Riedon
R21	55-10168ELK010	Resistor, F.F., 10K Ohm, 1/8W, 1%	Dale
R22	55-10101HK005R6	Resistor, C.C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R23	55-10101HK005R6	Resistor, C.C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R24	55-10101HK005R6	Resistor, C.C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R25	55-10101HK006R8	Resistor, C.C., 6.8K Ohm, 1/4W, 5%	IRC, GBT 1/4
R26	55-10102HA750	Resistor, C.C., 750 Ohm, 1/2W, 5%	Piher
R27	55-10168ELA049R9	Resistor, F.F., 49.9 Ohm, 1/8W, 1%	Dale
R28	55-10101HK022	Resistor, C.C., 22K Ohm, 1/4W, 5%	IRC, GBT 1/4
R29	55-10101HK012	Resistor, C.C., 12K Ohm, 1/4W, 5%	IRC, GBT 1/4
R30	55-10101HA240	Resistor, C.C., 240 Ohm, 1/4W, 5%	IRC, GBT 1/4
R31	55-10101HK005R6	Resistor, C.C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R32	55-10101HK005R6	Resistor, C.C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4

* Reference Number can be found on the corresponding assembly drawing.

HTC Option Board Parts List (cont.)

*Reference Number	Digitec P/N	Description	Vendor
R33	55-10101HK005R6	Resistor, C.C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R34	55-10101HK100	Resistor, C.C., 100K Ohm, 1/4W, 5%	IRC, GBT 1/4
R35	55-10101HK100	Resistor, C.C., 100K Ohm, 1/4W, 5%	IRC, GBT 1/4
R36	55-10101HK005R6	Resistor, C.C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R37	55-10101HK022	Resistor, C.C., 22K Ohm, 1/4W, 5%	IRC, GBT 1/4
R38	55-23441DEK010	Resistor, F.F., 10K Ohm, 1/10W, 0.5%	PRP
R39	55-10101HK012	Resistor, C.C., 12K Ohm, 1/4W, 5%	IRC, GBT 1/4
R40	55-10101HK012	Resistor, C.C., 12K Ohm, 1/4W, 5%	IRC, GBT 1/4
R41	55-10101HK005R6	Resistor, C.C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R42	55-10101HK005R6	Resistor, C.C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R49	55-10168DDGK001R2	Resistor, F.F., 1.2K Ohm, 1/8W, 0.5%	Dale
R50	55-23441DEK010	Resistor, F.F., 10K Ohm, 1/10W, 0.5%	PRP
R51	55-23441DEK003R01	Resistor, F.F., 3.01K Ohm, 1/10W, 0.5%	PRP
R53	55-10101HK010	Resistor, C.C., 10K Ohm, 1/4W, 5%	IRC, GBT 1/4
R54	55-10101HK001	Resistor, C.C., 1K Ohm, 1/4W, 5%	IRC, GBT 1/4
R55	55-10101HK003R3	Resistor, C.C., 3.3K Ohm, 1/4W, 5%	IRC, GBT 1/4
R56	55-10101HK008R2	Resistor, C.C., 8.2K Ohm, 1/4W. 5%	IRC, GBT 1/4
R58	55-10101HK001	Resistor, C.C., 1K Ohm, 1/4W, 5%	IRC, GBT 1/4
R59	55-10102HA750	Resistor, C.C., 750 Ohm, 1/2W, 5%	Piher
U1	40-23150	IC, Opto-Isolator, HCPL2731	Hewlett-Packard
U2	07-23416	EPROM, Programmed	Digitec
U3	40-23149	IC, D/A Converter, DAC800P-CB1-V	Burr-Brown
U4	40-23150	IC, Opto-Isolator, HCPL2731	Hewlett-Packard
U5	40-23153	IC, DPTR, ±15V, LM325H	National Semiconductor
U6	40-23132-01	IC, Current Transmitter, XTR110	Burr-Brown
U7	40-23384-06	IC, Quad Op Amp, LT1014DN	Linear
VR1	40-23079	Regulator, +5V w/Reset, LM2925T	Pac-Tec
VR2	40-16082	Regulator, +12V MC78M12	National
VR3	40-18203	Regulator, 12V, MC7812CT	Fairchild
Y1	40-19735-10	Crystal, 6MHz	M-Tron

* Reference Number can be found on the corresponding assembly drawing.

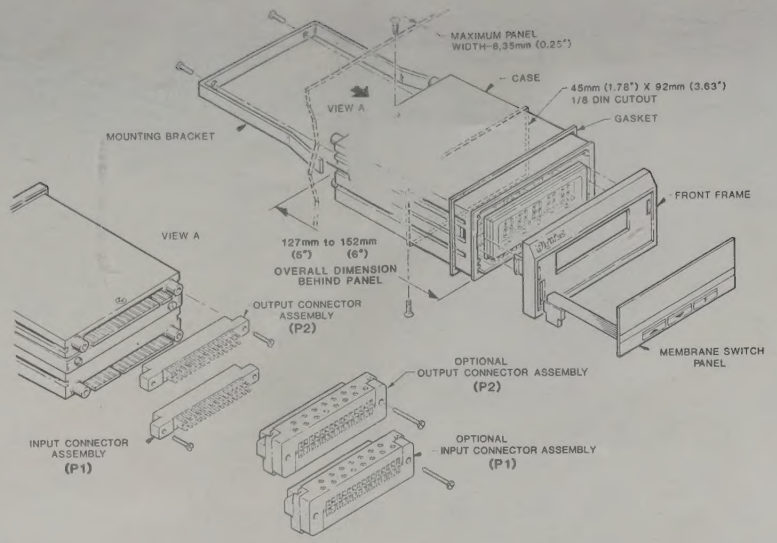


Figure 19. Miscellaneous Parts

Miscellaneous Parts List

Digitec P/N	Description	Vendor
30-22941-00	Case	Digitec
30-22941-01	Case (Used With Option H)	Digitec
16-22385	Gasket	Digitec
25-22984	Front Frame	Digitec
31-23002-00	Membrane Switch Panel	Digitec
31-23501	Membrane Switch Panel (Used With Option D)	Digitec
34-23017	Mounting Bracket	Digitec
04-23188	Input Connector Assy	Digitec
04-23192	Optional Input Connector Assy (Screw Terminals)	Digitec
04-23188	Output Connector Assy	Digitec
04-23192	Optional Output Connector Assy (Screw Terminals)	Digitec

Miscellaneous Parts List (cont.)

Digitec P/N	Description	Vendor
55-10165EGM001	Resistor, F. F., 1M Ohm, 1W, 1% (R101 on connector of models 2810A-02, 2811A-02, 2812A-02, 2820A-23, 2820A-25)	Digitec
55-10165EGM009R99	Resistor, F. F., 9.99M Ohm, 1W, 1% (R101 on connector of models 2810A-03, 2810A-04, 2811A-03, 2811A-04, 2812A-03, 2812A-04)	Digitec
55-22443DDK100	Resistor, M. F., 100K Ohm, 1/8W, .5% (R102 on connector of models 2810A-02, 2810A-03, 2811A-02, 2811A-03, 2812A-02, 2812A-03, 2820A-23, 2820A-25)	Digitec
55-22443DDK010	Resistor, M. F., 10K Ohm, 1/8W, .5% (R102 on connector of models 2810A-04, 2811A-04, 2812A-04)	Digitec
55-10121DBK001	Resistor, Wire Wound, 1K Ohm, 1W, .5% (R102 on connector of models 2810A-08, 2811A-08)	Digitec
55-10121DBA100	Resistor, Wire Wound, 100 Ohm, 1W, .5% (R102 on connector of models 2810A-09, 2811A-09)	Digitec
55-10121DBA010	Resistor, Wire Wound, 10 Ohm, 1W, .5% (R102 on connector of models 2810A-10, 2811A-10)	Digitec
55-10121DEA001	Resistor, Wire Wound, 1 Ohm, 1W, .5% (R102 on connector of models 2810A-11, 2811A-11)	Digitec
55-10121DEA000R1	Resistor, Wire Wound, 0.1 Ohm, 1W, .5% (R102 on connector of model 2810A-12)	Digitec
55-10119DBA050	Resistor, Wire Wound, 50 Ohm, 1/2W, .5% (R102 on connector of model 2820A-27)	Digitec
55-10119DBA020	Resistor, Wire Wound, 20 Ohm, 1/2W, .5% (R102 on connector of model 2820A-29)	Digitec

NOTE: Figures 3B and 3C show the locations of R101 and R102.

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